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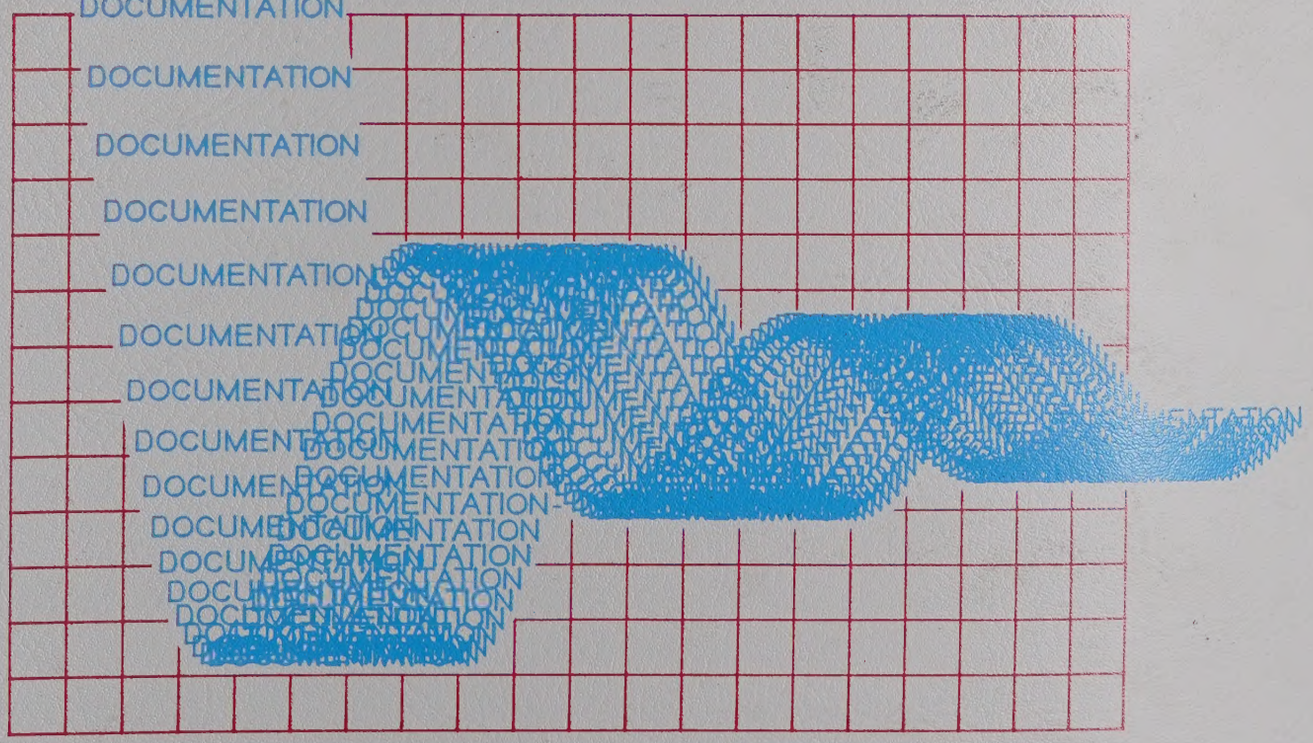


MP MASTER

MA20542

ROHDE&SCHWARZ

Test and Measurement Division

Operating Manual

Universal Radio Communication Tester

CMU200

1100.0008.02

Printed in the Federal Republic of Germany

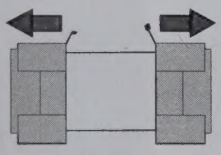
Instructions

CMU200 – Equipment Supplied

The CMU is delivered with the following items:

- Universal Radio Communication Tester CMU200.
- An AC power cable.
- The following documentation:
  - The present operating manual for CMU200.
  - Service manual instrument.
  - Operating manuals for software options purchased with the CMU. All available software manuals are listed before tabbed divider no. 1 of this manual. For a list of options available refer to the data sheet.

Instructions for Unpacking the Instrument



remove protective cabs

- ➢ Take the instrument out of the shipping box and check whether the items listed in the packing list above are all included.
- ➢ Remove the two protective caps from the front and rear of the CMU and carefully check the instrument for damage.

Should the instrument be damaged, immediately notify the forwarder who shipped the instrument to you and keep the box and packing material.

Please observe all safety instructions given in this manual and follow the directions in chapter 1 to put the instrument into operation.

Remote Control – Basics

Remote Control – Commands

Remote Control – Programming Examples

Maintenance and Hardware Interfaces

Error Messages

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Certificate of Quality
EU Certificate of Conformity
List of R&S Representatives

Manuals for Universal Radio Communication Tester CMU

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Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

Observe operating instructions

Weight indication for units >18 kg

PE terminal

Ground terminal

Danger! Shock hazard

Warning! Hot surfaces

Ground

Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, Pollution severity 2, overvoltage category 2, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. Any additional safety instructions given in this manual are also to be observed.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

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EC Certificate of Conformity

CE

Certificate No.: 99035

This is to certify that:

Equipment type	Order No.	Designation
CMU200	1100.0008.02	Universal Radio Communication Tester
CMU-B11	1100.5000.02	Option: Reference Oscillator OXCO
CMU-B12	1100.5100.02	Option: Reference Oscillator OXCO
CMU-B15	1100.6006.02	Option: Additional RF und IF Connections
CMU-B21	1100.5200.02	Option: Versatile Signalling Unit
CMU-B41	1100.5300.02	Option: Audio Generator and Analyzer
CMU-B52	1100.5400.02	Option: Spreech Codec for Versatile Signalling Unit
CMU-Z1	1100.7490.02	Accessory: Memory Card

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1993 + A2 : 1995
EN50081-1 : 1992
EN50082-2 : 1995

Affixing the EC conformity mark as from 1999

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Munich, 1999-11-26

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Contents of Manuals for Universal Radio Communication Tester CMU

Operating Manual CMU

The present operating manual contains comprehensive information about the technical data of the instrument, its setup and putting into operation, the operating concept and controls as well as the operation of the CMU via the menus of the graphical user interface and via remote control. Typical measurement tasks for the CMU are explained in detail using the functions offered by the graphical user interface and a selection of program examples.

The manual is subdivided into the data sheet plus 9 chapters:

The data sheet	informs about guaranteed specifications and characteristics of the instrument.
Chapter 1	describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the instrument into operation and integration into a test system.
Chapter 2	gives an introduction to typical measurement tasks of the CMU which are explained step by step.
Chapter 3	describes key operating modes, the structure of the graphical interface and the principles of measurement control.
Chapter 4	forms a reference for manual control of the CMU and contains a detailed description of all instrument functions and their application. The chapter also lists the remote control command corresponding to each instrument function.
Chapter 5	describes the basics for programming the CMU, command processing and the status reporting system.
Chapter 6	lists all the remote-control commands defined for the instrument. At the end of the chapter a list of commands arranged by measurement and configuration groups is given.
Chapter 7	contains program examples for a number of typical applications of the CMU.
Chapter 8	describes preventive maintenance and the characteristics of the instrument's hardware interfaces.
Chapter 9	gives a list of error messages that the CMU may generate.
Chapter 10	contains an index for the operating manual.

Operating Manual CMU-K21/-K22/-K23 (Software Options: GSM900/1800/1900 for CMU-B21)

The operating manual CMU-K21/-K22/-K23 describes the test of GSM mobile phones by means of the CMU and the software options GSM900/1800/1900 for CMU-B21. Except for hardware-specific chapters that are not relevant for the software options, the structure of the GSM900/1800/1900 operating manual is analogous to the CMU operating manual.

Service Manual Instrument

The service manual instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for the maintenance of CMU by exchanging modules.

Service Manual Modules

The service manual modules is not delivered with the instrument but may be obtained from your R&S service department using the order number 1100.4903.91.

Service manual modules contains information about the individual modules of CMU. This comprises the test and adjustment of the modules, fault detection within the modules and the interface description.

Frequently Used Abbreviations

Att.	*Attenuation*
Cnt	*Center*
Ext.	*External*
Freq.	*Frequency*
GPIB	*General Purpose Interface Bus = IEEE Bus*
IF	*Intermediate Frequency*
Max.	*Maximum (Level)*
Pk	*Peak*
RBW	*Resolution Bandwidth*
Ref.	*Reference*
Rel.	*Relative*
RF	*Radio Frequency*
SSB	*Single Side Band*
SW	*Software*

Supplement to the Operating Manual for Universal Radio Communication Tester CMU200

Corrections to the data sheet, no. 757.4318.21 (1099)

VSWR at RF1 socket			**page 12**
10 MHz	to	2000 MHz	<1.2
2000 MHz	to	2200 MHz	<1.3
2200 MHz	to	2700 MHz	<1.6

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1 Putting into Operation 1.1

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Rear View **1.7**

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Switching on the Instrument / Startup Test 1.10

Switching off the Instrument 1.12

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Input Level 1.12

Connecting the CMU to the Test Setup **1.13**

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Connecting an External Keyboard 1.14

Connecting a Monitor 1.15

Connecting a Printer 1.15

Synchronization with External Devices; Connection of Further Components 1.16

Software Update **1.17**

1 Putting into Operation

This chapter describes the controls and connectors of the Universal Radio Communication Tester CMU and gives all information that is necessary to put the instrument into operation and connect external devices. Notes on reinstallation of the CMU software terminate this chapter.

Caution!

Please make sure to observe the instructions of the following sections in order not to cause damage to the instrument or endanger people. This is of particular importance when the instrument is used for the first time. Also observe the general safety instructions at the beginning of this manual.

A more detailed description of the hardware connectors and interfaces can be found in chapter 8. Chapter 2 provides an introduction to the operation of the CMU by means of typical examples of configuration and measurement; for the description of the concept for manual operation refer to chapter 3.

For remote control of the CMU refer to the general description of the SCPI commands, the instrument model, the status reporting system and measurement control in chapter 5.

Front and Rear View

The front panel of the CMU consists of the VGA display with the softkey area (left side) and the hardkey area (right side, see Fig. 1-1). Brief explanations on the controls and connectors of the hardkey area and the rear panel are to be found on the next pages. Operation by means of softkeys is described in chapter 3, *Manual Operation*.

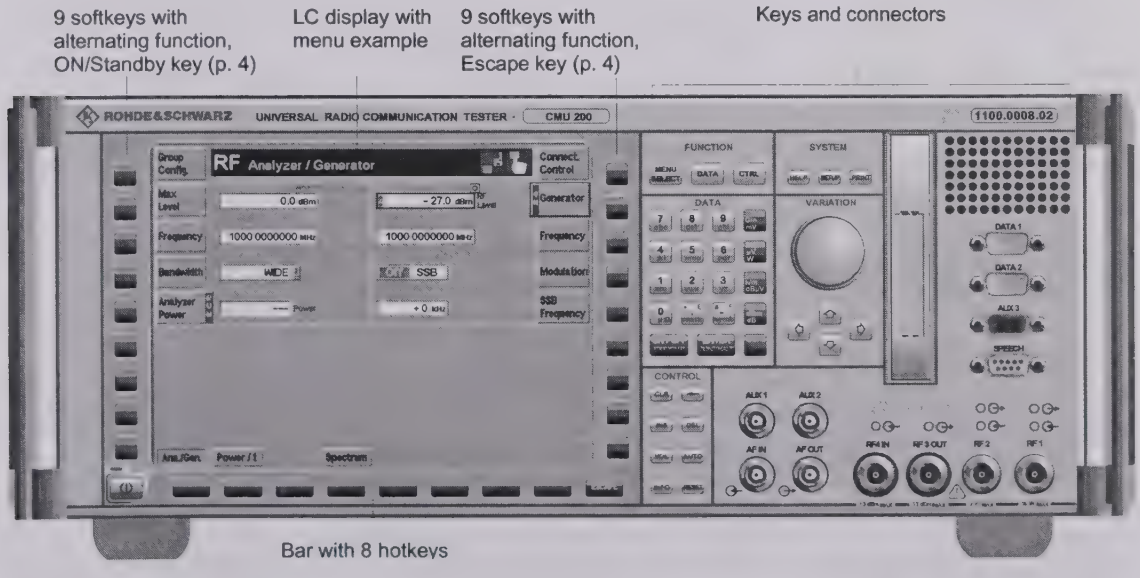


Fig. 1-1 CMU front view

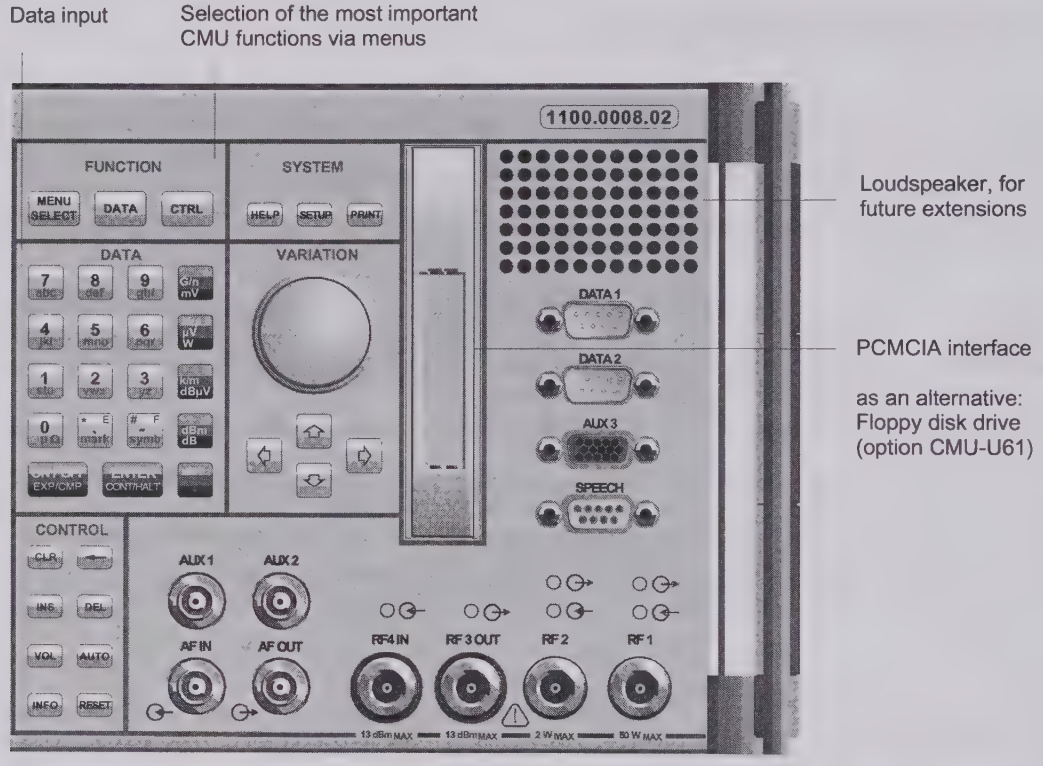
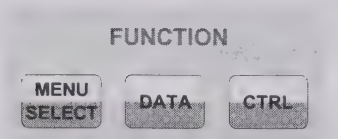


Fig. 1-2 CMU front view – hardkeys

FUNCTION



Preselection of the menus:

MENU SELECT	Menu selection	☞ Chap. 3
DATA	For future extensions	
CTRL	For future extensions	

DATA

Data input:

0 ... 9	Numerical input (letters for string editors)	☞ Chap. 3
** . E*	Special characters, dec. point, hex value "E"	
# - F	Spec. characters, sign change, hex value "F"	
G/n mV A	Factor $10^9/10^{-9}$, unit, hex value "A"	
M/µ µV W	Factor $10^6/10^{-6}$, unit, hex value "B"	
k/m dB µV	Factor $10^3/10^{-3}$, unit, hex value "C"	
**1 dBm dB*	Factor 10^0, unit, hex value "D"	
ON / OFF EXP/COMP	Switching on/off editors/measurements	
ENTER	Confirmation of entry in editors	
CONT/HALT	Calling/quitting editors, measurement control	
UNIT..	For future extensions	

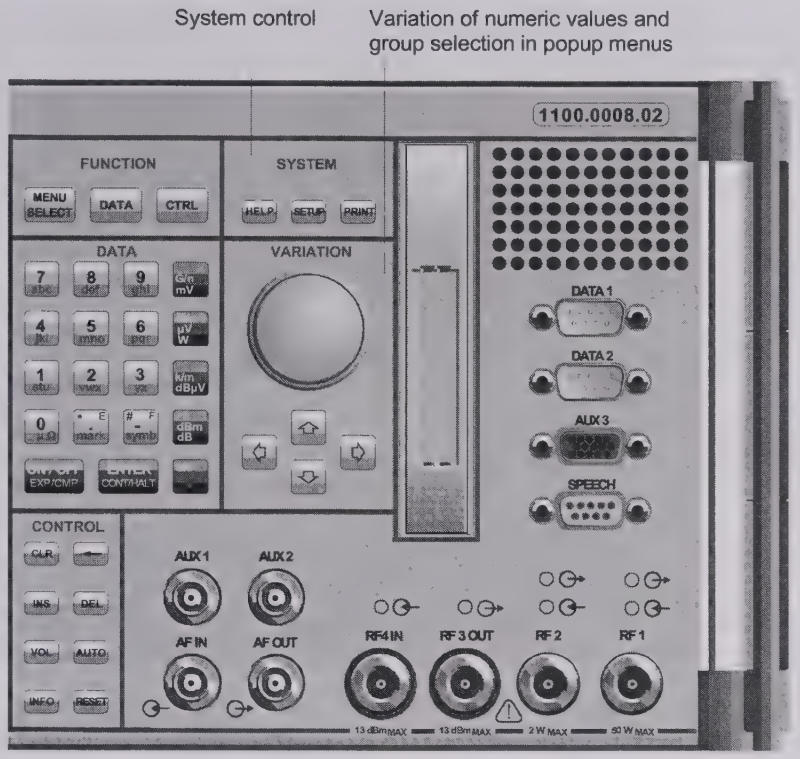
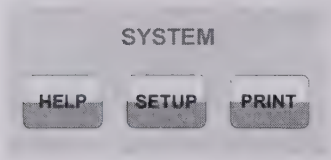


Fig. 1-3 CMU front view – hardkeys

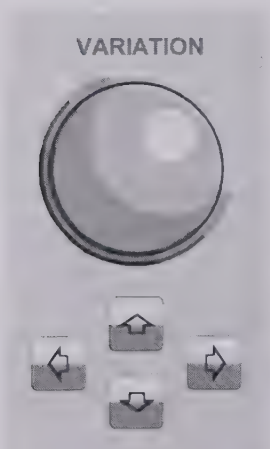
SYSTEM



System control:

HELP	For future extensions	☞ Chap. 3
SETUP	Instrument settings	
PRINT	Initialize printing of a screenshot	

VARIATION



Value variation and group selection:

Rotary knob	Value variation in input fields and parameters, line selection in tables, field selection in popup menus. Press to expand/compress tables and pull-down lists and to confirm entries and selections.	☞ Chap. 3
Cursor key vertical	Group selection in popup menus (vertical)	
Cursor key horizontal	Group selection in popup menus (horizontal), Cursor positioning in editors and tables	

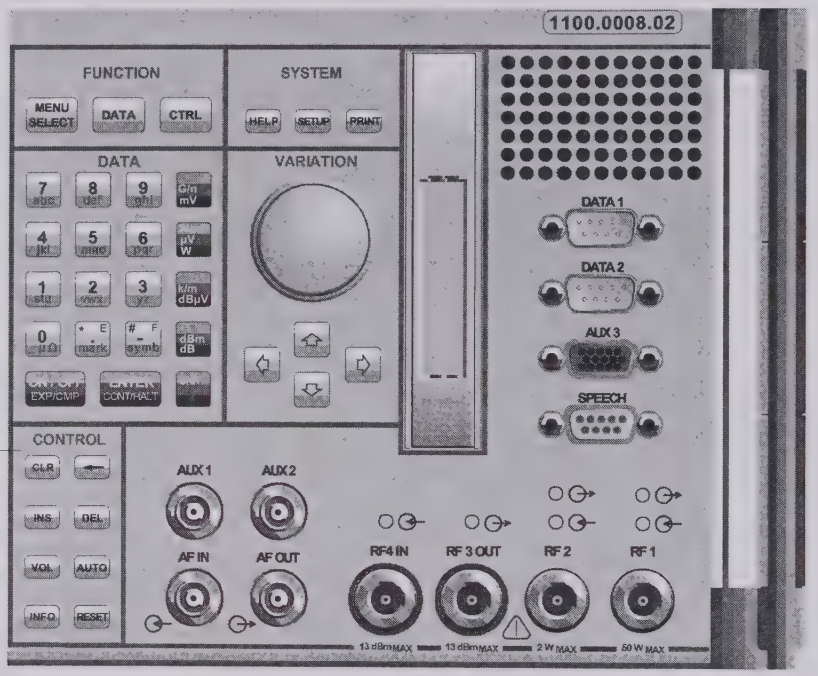


Fig. 1-4 CMU front view – hardkeys

CONTROL

Extended control functions:

CLR	Clears the complete editor string	☞ Chap. 3
⇦	Deletes the character to the left of the cursor (back space)	
INS	Changes between insertion and overwriting in the editor	
DEL	Deletes the character marked by the cursor	
VOL	For future extensions	
AUTO	For future extensions	
INFO	For service activities only	
RESET	Resets to default values	

Further Keys

ESCAPE	Quits popup menus, closes an editor discarding the entries made	☞ Chap. 3

ON/STANDBY	Switches between operation (green LED) and standby (orange LED)

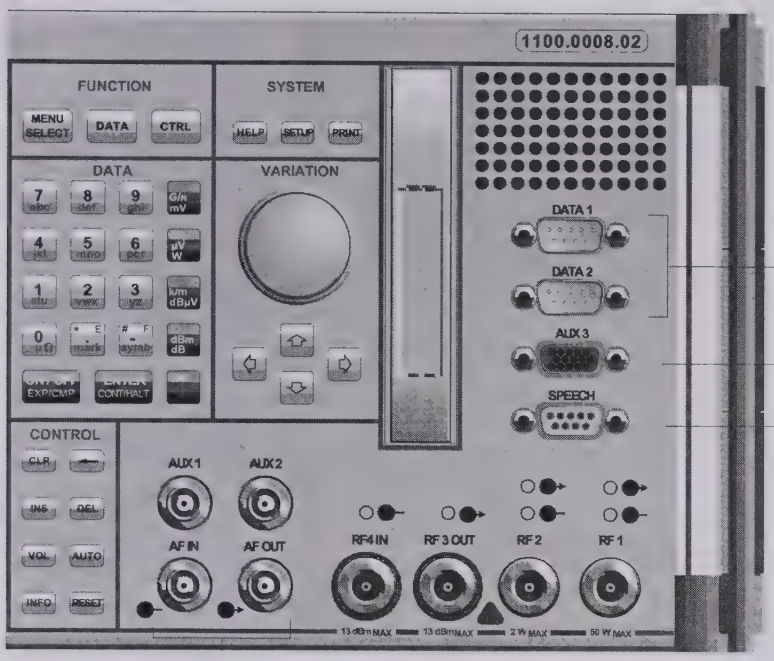
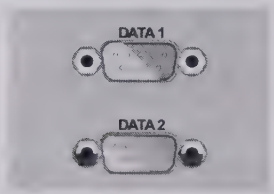


Fig. 1-5 CMU front view - connectors

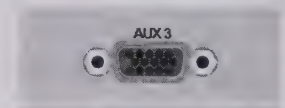
DATA1, DATA2



For future extensions

☞ Chapter 8, "Hardware connectors"

AUX 3 and SPEECH



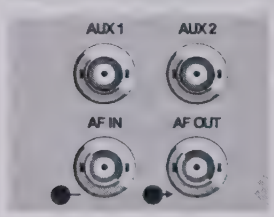
Bidirectional input/output for digital status, control and trigger signal

☞ Chapter 8, "Hardware connectors "

Signals from/to speech codec (option CMU-B52)

☞ Chapter 8, "Hardware connectors"

AF connectors



Connectors for audio signals:

AUX1/2 Additional input/output for audio signals that may be used in remote control (secondary audio analyzer)

AF IN/OUT Standard input/output for the (primary) audio analyzer

☞ Chapter 4, "Audio Generator and Analyzer"; Chapter 8, "Hardware connectors"

Caution: *Note the maximum permissible input levels for all AF connectors according to the data sheet in order to prevent damage to the instrument!*

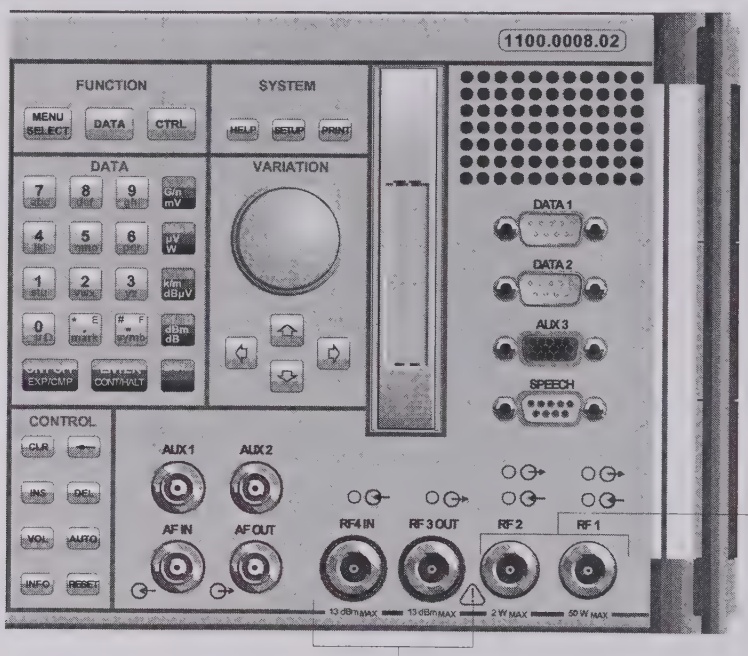
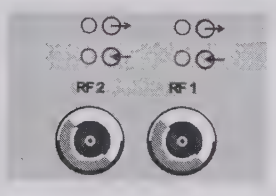


Fig. 1-6 CMU front view– connectors

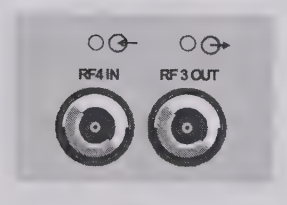
RF connectors



Bidirectional RF connectors for various power ranges according to the data sheet.

The two LEDs above the connectors are illuminated as long as the CMU sends signals ⊖→ or is ready for reception ⊖←.

☞ Chapter 8, "Hardware connectors "



Connector with high output level and connector for sensitive RF measurements (antennas). Power ranges according to the data sheet. Maximum permissible input and output level according to the label on the front panel.

☞ Chapter 8, "Hardware connectors"

The two LEDs above the connectors are illuminated as long as the CMU sends signals ⊖→ or is ready for reception ⊖←.

Caution:

Note the maximum permissible input levels for all RF connectors according to the label on the front panel or the data sheet in order to prevent damage to the instrument!

RF connectors may warm up very much when high RF power is fed in!

Rear View

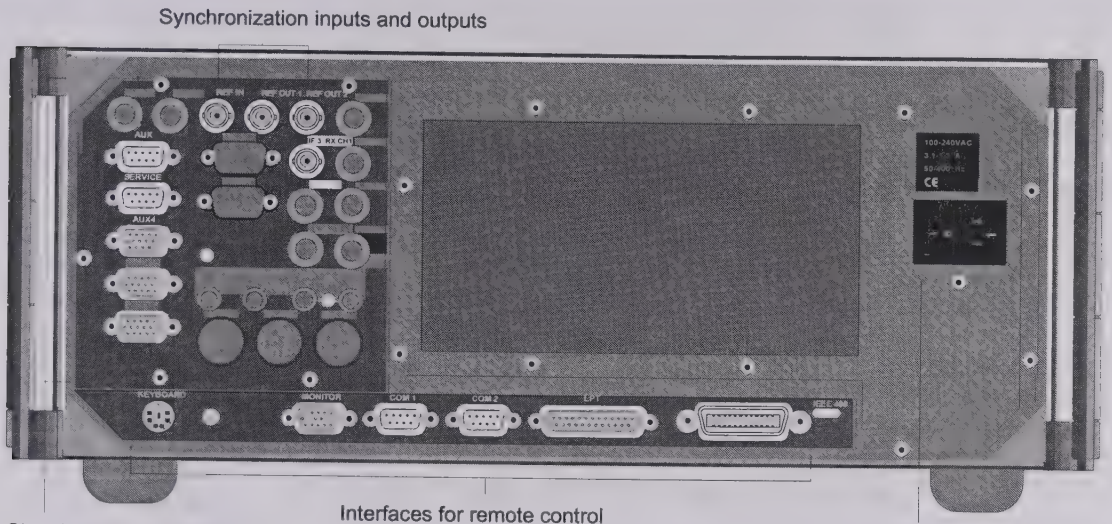
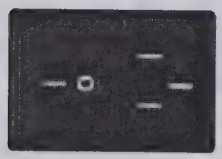

Synchronization inputs and outputs
Signal inputs and outputs
Interfaces for remote control and peripheral equipment
Mains connector with switch

Fig. 1-7 CMU rear view

Mains switch



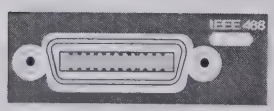
Mains power switch

☞ Chapter 1, "Switching on the Instrument, Startup test"

Mains connector

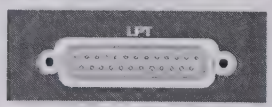
☞ Chapter 1, "Connecting the instrument to the AC supply"

Interfaces



IEC-bus connector (IEEE 488/IEC 625),

☞ Chapter 8, "Hardware Interfaces "



Parallel interface: 25-contact printer connector, Centronics-compatible

☞ Chapt. 1, "Connecting an Output Device"
Chapter 8, "Hardware Interfaces"

Connector for serial interface 1: 9-contact Sub-D connector

☞ Chapter 8, "Hardware Interfaces"

Connector for serial interface 2: 9-contact Sub-D connector

☞ Chapter 8, "Hardware Interfaces"

Connector for an external VGA monitor: 15-contact Sub-D connector

☞ Chapter 1, "Connecting a Monitor"
Chapter 8, "Hardware Interfaces"

Connector for external keyboard (PS/2), 6-contact Mini DIN connector

☞ Chapter 1, "Connecting an External Keyboard"
Chapter. 8, "Hardware Interfaces"

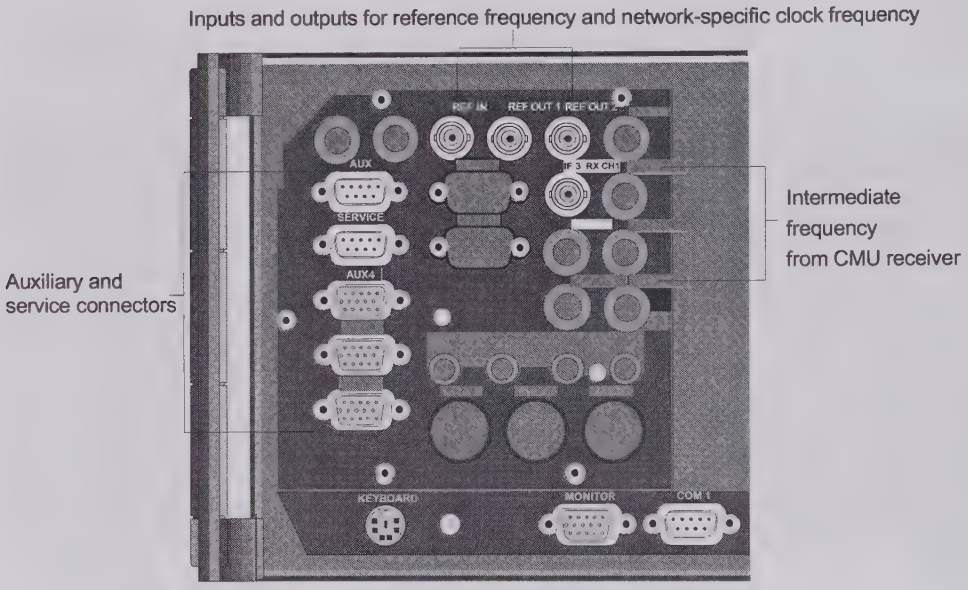


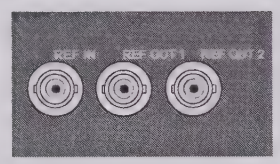
Fig. 1-8 CMU rear view: Signal inputs and outputs

Intermediate frequency

IF3 RX CH1 (BNC connector) from CMU receiver

☞ Chapter 8, "Hardware Connectors"

Reference frequency

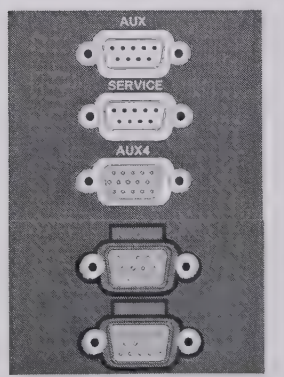


REF IN	Input for external reference frequency	☞ Chapter 8, "Hardware Connectors
REF OUT 1	Output of reference frequency of CMU: 10 MHz or the signal of input REF IN	
REF OUT 2	Output for network-specific clock frequency	☞ Chapter 3, "RF Connection Control"

Caution!

Do not use open or unshielded cables in order to comply with EMC directives!

AUX, SERVICE, AUX4, extensions



Two 9-contact and one 15-contact SUB-D connector:

☞ Chapter 8, "Hardware Connectors

AUX	Auxiliary connector
SERVICE	Service connector for RXTX board (only for internal test purposes)
AUX4	Bidirectional input/output for digital status, control, and trigger signal

The remaining 15-contact SUB-D connectors are reserved for future extensions.

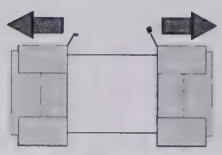
☞ Chapter 8, "Hardware Connectors

Putting into Operation

Caution!

Please make sure to follow the instructions of the following sections in order not to cause damage to the instrument or endanger people. This is of particular importance when using the instrument for the first time.

Unpacking the Instrument



remove protective cabs

- Take the instrument out of the shipping box and check whether the items listed in the packing list (see separate yellow sheet after the title page of this manual) are all included.
- Remove the two protective caps from the front and rear of the CMU and carefully check the instrument for damage.

Should the instrument be damaged, immediately notify the forwarder who shipped the instrument to you and keep the box and packing material.

For further transport or shipment of the CMU the original packing should be used, too. It is recommended to keep at least the two protective caps for front and rear side in order to prevent damage to the controls and connectors. The caps are also necessary if the CMU is transported in its transit case that can be ordered from Rohde & Schwarz.

Setting up the Instrument

Permissible operating positions of the CMU

- Horizontal position, standing on the feet.
- Tilted with the tilt stand on the bottom of the instrument opened out. This is recommended for applications in the laboratory or on a work bench where it provides the optimum viewing angle for the LCD display.

Warning!

To ensure stability of the instrument and thus avoid accidents, always make sure that the tilt stand is either folded in or ***completely*** *opened out. In the latter case, do not pile up other instruments or objects onto your CMU.*

Notes: *For safe and convenient operation of the instrument note the following:*

- Do not cover the rear and lateral ventilation holes.
- Note the permissible ambient temperature according to the data sheet.
- Avoid moisture condensation. If it however occurs, the instrument must be wiped dry before switching on.
- Note the warm-up time of the temperature-controlled OCXO reference oscillator (Option CMU-B11/B12), see data sheet.

Mounting in a Rack

Using the adapter ZZA-411 (order number 1096.3283.00) the instrument can be mounted in 19" racks according to the mounting instructions supplied with the rack adapter.

Note: *For convenient operation of the instrument note the following:*

- Allow for sufficient air supply in the rack.
- Make sure that there is sufficient space between the ventilation holes and the rack casing.

Connecting the Instrument to the AC Supply

Caution!

After moisture condensation, allow the instrument to dry before switching on.

Note the permissible ambient temperature according to the data sheet..

Do not cover the lateral and rear ventilation holes.

The CMU may be connected to one-phase AC supplies with nominal voltages ranging from 100 V to 240 V and nominal frequencies ranging from 50 Hz to 400 Hz (see inscription on the rear panel and data sheet). Depending on the options installed, the power consumption ranges from 120 W to 230 W.

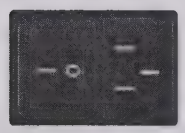
Note: *The CMU is automatically adapted to the AC supply voltage applied. External switchover or adaptation of the fuses are not necessary.*

Mains connector

For the mains connection use the supplied mains connector.

As the instrument is designed according to the regulations for safety class EN61010, it must be connected to a power outlet with earthing contact.

Switching on the Instrument / Startup Test



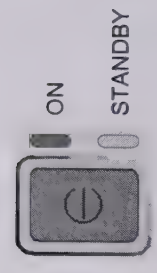
Mains switch

The CMU can be switched on using the mains switch at the rear of the instrument and the *ON/STANDBY* key at the bottom left of the instrument front.

The *mains switch* can be set to two positions:

0 The *0* position implies an all-pole disconnection of the instrument from the mains.

I In the *I* position, the instrument is in standby mode or in operation, depending on the position of the ON/STANDBY key at the front of the instrument.



ON/ STANDBY key

The *ON/STANDBY* key activates two different operating modes indicated by colored LEDs:

Standby Only the OCXO reference frequency oscillator (Option CMU-B11/B12), if installed, is supplied with operating voltage. The orange LED (STANDBY) on the right is illuminated.

Operation In this operating mode, all modules of the instrument are supplied with operating voltage. The green LED (ON) on the left is illuminated.

Start procedure

➢ To switch on the CMU set the mains switch to the position I.

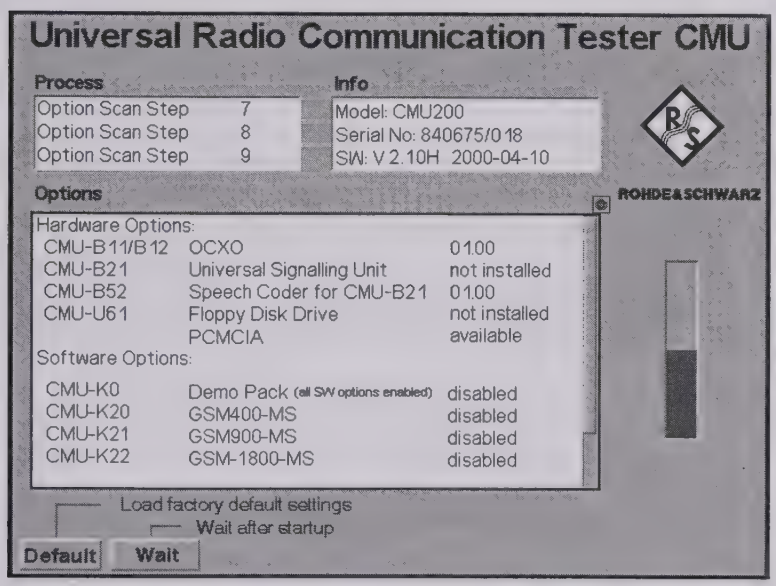
The CMU enters standby mode.

➢ Set the CMU to operating mode by pressing the *ON/STANDBY* key once.

Caution! *When switching on the CMU, no disk should be inserted in the drive; otherwise, one of the actions stored on the flash disk will be performed.*

Startup menu

After activation of the operating mode, the startup menu appears for a few seconds. While it is displayed the CMU performs a startup test.



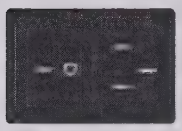
Displays in startup menu

The display windows of the startup menu provide information on

- the startup test procedure *(Process)*,
- instrument model, serial number and software version *(Info)*,
- installed options, equipment and Firmware *(Options)*,
- the relative progress of the startup procedure (bar graph).

After the startup procedure has been terminated, the instrument changes to the last measurement menu activated in the previous session.

Switching off the Instrument



Mains switch

In order not to lose any settings that have been made, proceed in the following order to switch off the CMU:

- ➢ Remove any storage medium from the PCMCIA interface or floppy disk drive.
- ➢ Set the *ON/STANDBY* key to standby mode by pressing once.
- ➢ Set the mains switch at the rear to the 0 position.

How to Ensure EMC

In order to avoid electromagnetic interference, the instrument may only be operated when it is closed and with all shielding covers fitted. Only appropriate shielded signal and control cables may be used.

Input Level

Caution!

– *In order to prevent damage to the instrument note the maximum permissible input levels at the AF inputs AF IN and AUX 1 as well as for the RF inputs RF 1, RF 2 and RF 4 IN at the front of the instrument.*

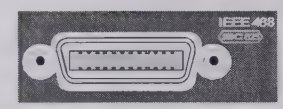
Connecting the CMU to the Test Setup

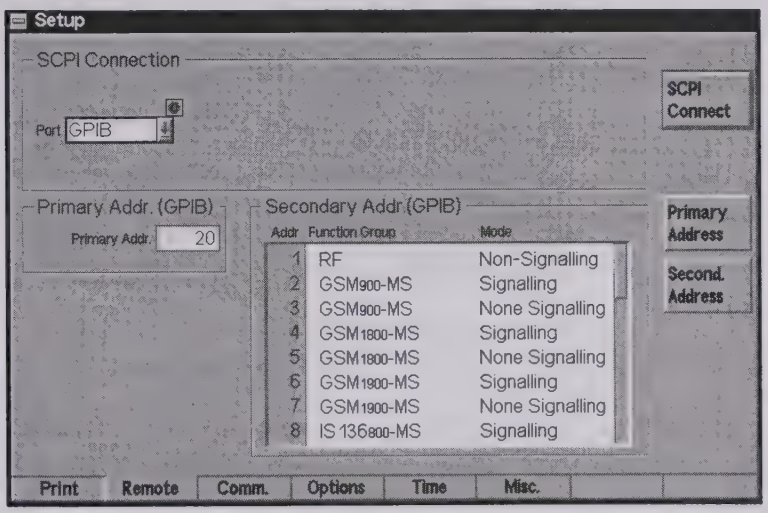
Connecting a Controller

The CMU can be connected to an external controller via the GPIB bus (IEEE bus according to standard IEEE 488; throughout this documentation we will primarily use the term GPIB bus which is also used in the operating menus and in the SCPI command syntax) or via serial interface:

Connection via GPIB bus

The CMU is connected to the GPIB interface of the controller via the GPIB bus connector (IEEE 488 / IEC 625) at the rear of the instrument and a shielded cable. The technical specifications of the GPIB interface are listed in section "Hardware Interfaces " in Chapter 8.





GPIB Bus Configuration

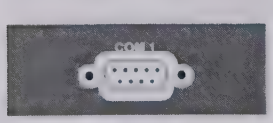
The parameters for GPIB bus control of the CMU are set via the popup menu *Remote* in the menu group *Setup* (in the following abbreviated by *Setup – Remote,* see also chapter 4, p. 4.5, *Settings for Remote Control*).

- To open the menu *Setup - Remote* press the *SETUP* key at the front of the instrument and activate the *Remote* hotkey at the lower edge of the screen.
- Select the IEC-bus interface for the transmission by means of the setting *GPIB* in the list field *Port* of the softkey *SCPI Connect.*

The bus address is factory-set to 20. It can be changed in the input field of the softkey *Primary Address.*

Connection via serial interface

The CMU can be connected to the serial interface of a controller via one of the serial interfaces COM 1 or COM 2 and a so-called null-modem cable. The pin assignment and wiring of a null-modem cable are described in section *Handshake* of chapter 8. The technical specifications of the serial (RS-232-C) interface are also discussed in chapter 8 (refer to section *Hardware Interfaces*).



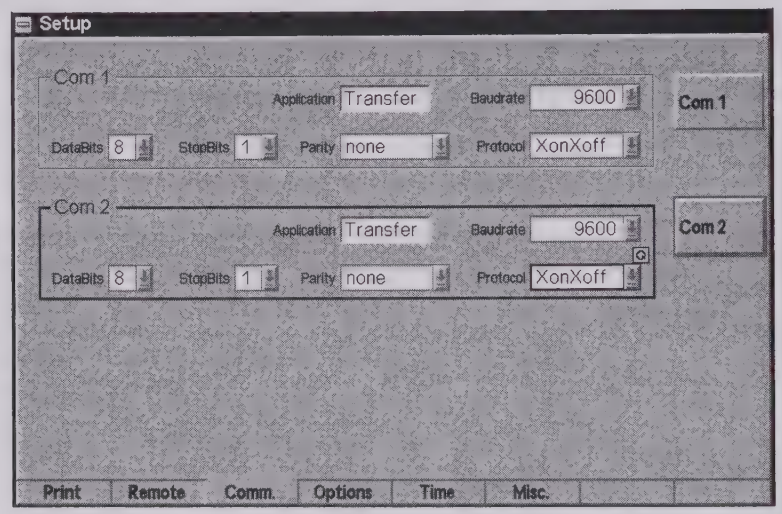
Either a 25-pin or a 9-pin connector can be used on the controller side. It may be necessary to use an appropriate adapter (see chapter 8, *Hardware Interfaces*).

Selection

➢ In the *Port* list field of the *SCPI Connect* softkey, select COM 1 or COM 2 to activate one of the RS-232 interfaces for data transfer.

Configuration

After selection of a serial interface, the transmission parameters must be set such as to comply with the parameters of the addressed device. This is done in *the Comm. (communications)* tab of the *Setup* menu:



➢ To open the menu *Setup – Comm.* press the *SETUP* key at the front of the instrument and activate the *Comm.* hotkey at the lower edge of the screen.

➢ Press the softkey corresponding to the selected COM port and check the settings for the *Baudrate, Data Bits, Parity,* and *Protocol.*

Connecting an External Keyboard

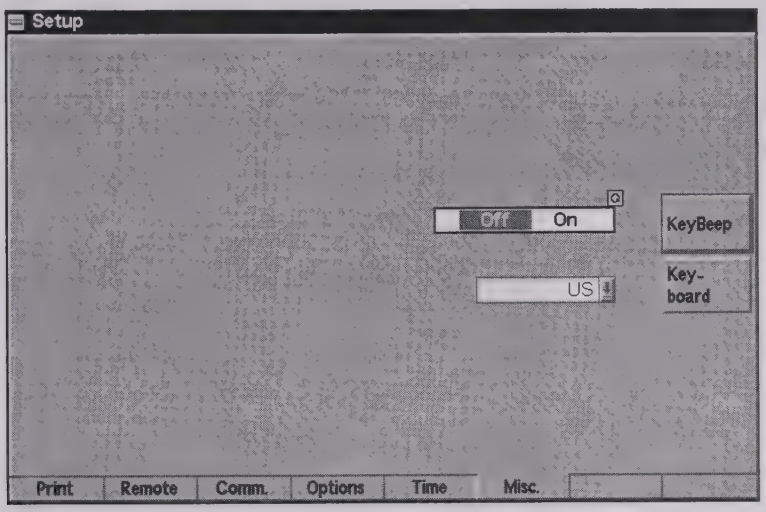
The 6-contact Mini DIN connector at the rear of the instrument permits to connect an external PC keyboard (PS/2) to the CMU. An external keyboard facilitates the input of numbers and texts.

For the interface description see section "Hardware Interfaces" in chapter 8.

Warning:

Connect the keyboard only when the instrument is switched off or in STANDBY mode. Otherwise, future error functions cannot be excluded.

The assignment of the keys can be changed in the *Misc.* tab of the *Setup* menu:



Language assignment

- To open the menu *Setup – Misc.* press the *SETUP* key at the front of the instrument and activate the *Misc.* hotkey at the lower edge of the screen.
- Press the *Keyboard* softkey and set the desired key assignment *(US* or *German).*

Connecting a Monitor

The 15-contact Sub-D connector at the rear of the instrument permits an external VGA monitor to be connected to the CMU.

For the interface description see section "Hardware Interfaces" in chapter 8.

Warning:

Connect a monitor only when the instrument is switched off or in STANDBY mode. Otherwise, future error functions cannot be excluded.

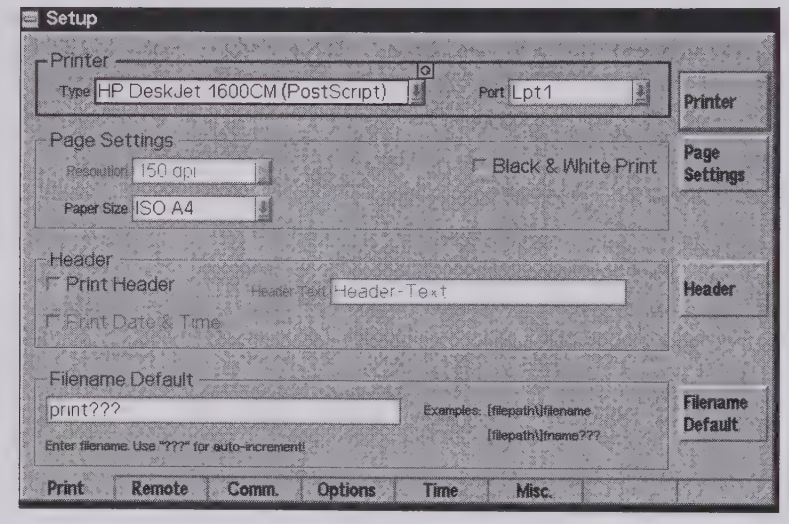
Connecting a Printer

A printer can be connected via the 25-contact parallel interface *LPT* at the rear of the instrument (recommended) or one of the serial interfaces COM 1 or COM 2. For the interface description see section "Hardware Interfaces" in chapter 8.

Warning:

Connect a output device only when the instrument is switched off or in STANDBY mode. Otherwise, future error functions cannot be excluded.

The printer type and port must be set in the *Print* tab of the *Setup* menu:

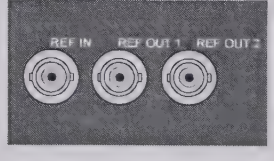


- To open the menu *Setup – Print* press the *SETUP* key at the front of the instrument and activate the *Print* hotkey at the lower edge of the screen.
- Press the *Printer* softkey and set the printer type and port *(COM 1* or *COM 2* for the serial (RS-232) ports; *LPT 1* for the parallel printer port).

It is recommended to connect the output device to the parallel interface *LPT*, if possible: With this selection, configuration of the interface is not necessary; besides, the other connectors may be used for IEC bus etc. The following printer types are supported:

HP DeskJet 1600CM (PostScript)
HP DeskJet 6MP (PostScript)
HP Laser Jet5 SimX (PostScript)
HP DeskJet 870 Cxi (PCL5)
Canon BubbleJet 250 (Canon)
Epson Stylus Color 600 (ESC)
HP DeskJet 1600CM (PCL5)
HP DeskJet 6MP (PCL5)
HP Laser Jet5 SimX (PCL5)

Synchronization with External Devices; Connection of Further Components



For synchronization of the CMU with external devices, the three BNC female connectors REF IN, REF OUT 1, REF OUT 2 are provided.

Software Update

Your CMU was delivered with the latest software and firmware version available. This includes a special software tool, the *VersionManager,* which was designed to install, load, activate, or delete different software versions in a convenient way. New software can be easily loaded via the floppy disk drive (option CMU-U61) or the PCMCIA interface (right-hand slot, mapped to drive d:\) on the front of the instrument. For detailed instructions refer to your service manual.

Installation instructions are also given in chapter 1 of the operating manuals for the individual software options.

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2 Getting Started

The following chapter presents a sample session with the universal radio communication tester CMU. It is intended to provide a quick overview of the settings provided in the base system and the *RF* function group. No specific device under test is required. For an introduction to mobile network tests (e.g. tests of GSM900/1800/1900 mobile phones) please refer to the relevant operating manuals.

Before starting any measurement with the CMU, please note the instructions given in chapter 1 for putting the instrument into operation. In chapters 2 to 4 you will find detailed information on customizing the instrument and the display according to your personal preferences.

The steps to perform are explained on the left side of each double-page together with the results obtained on the CMU screen. On the right side, additional information is given. We also point out alternative settings and related measurements which could not be reported in detail.

For a systematic explanation of all menus, functions and parameters and background information refer to the reference part in chapter 4.

A Short Tutorial on CMU Operation

The principles of manual operation – controls, operating menus, dialog elements and measurement control – are discussed in chapter 3. Below we list some essentials for first users:

Condensed Operating Instructions

1. When using CMU for the first time it is useful to set it to the default state (*RESET* hardkey).

2. *ENTER* key: press even if "No" or "Yes" is displayed.

3. There is no Home menu but the *MENU SELECT* hardkey can be pressed in any state of the unit. A large popup menu is then displayed in which the function group (network etc.), signalling mode and measurement menus can be selected. Activate by pressing *ENTER*.

4. Which of the RF connectors is configured as output is indicated by a front-panel LED. In the menu, the generator can be activated or deactivated with *ON/OFF* (green/red). The LED goes out if the generator is in the *OFF* position.

5. Which of the RF connectors is configured as input is indicated by a front-panel LED. In the menu, the measurement can be controlled via the *ON/OFF* and *CONT/HALT* keys (*ON* (green), *OFF* (red) and *HLT* (yellow) states). In the *OFF* state, the LED goes out.

6. The *SETUP* hardkey allows to make static, measurement-independent default settings such as Remote or Time, to check which options are built in and to activate new software options.

7. The left softkey row is missing in the graphics menus. The softkeys on the right-hand side are used to change the meaning of the hotkeys (bottom). Pressing the MENUS softkey (bottom right) allows a fast switchover between related menus using the hotkeys.

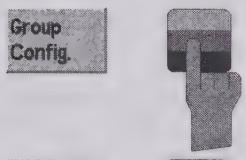
8. Signalling does not necessarily have to be activated by means of a general menu; for example, the *Power* menu for GSM mobile tests can be called up immediately, without transferring any signalling information. The user is popup-menu guided (as default) through the different CMU signalling states (messages: switch mobile on, registered, call setup). This menu guidance via popup menu can be switched off.

How to access and close menus

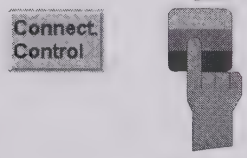
A startup menu is displayed automatically when the CMU is switched on.

Some general configuration and selection menus can be opened via the *MENU SELECT, RESET* or *SETUP* keys on the front panel.

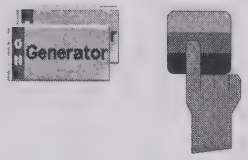
The hotkeys displayed across the bottom of a main menu or graphical measurement menu are used to switch over between different main menus or graphical measurement menus. Index cards in popup menus are also accessible via hotkeys.



The *Group Config.* softkey (always at the top left) is available in all measurement menus. After pressing this softkey all configurations of the current function group and signalling state can be carried out.



The *Connect. Control* softkey (always at the top right) is available in all measurement menus. After pressing this softkey, several index cards are available for setting the input/output, external attenuation, reference frequency (e.g. 10 MHz external) as well as further parameters.



If a special configuration menu exists for a measurement or for a generator the corresponding softkey is marked with a yellow arrow. The configuration menu is opened by pressing the softkey twice.

All small and large CMU popup menus can be closed with the ESCAPE *ESCAPE* key. Large popup menus (partly 90% of the screen) can be recognized by the header which is displayed twice.

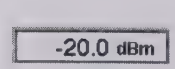
Main menus and graphical measurement menus are closed on switching to another main or graphical measurement menu.

How to use dialog elements in the menus

The dialog elements assigned to a softkey are selected by pressing the softkey.

Different entry fields can be selected by means of the 4 cursor keys (blue frame shows active entry field).

One of several elements in a list or toggle switch can be selected with the rotary knob.



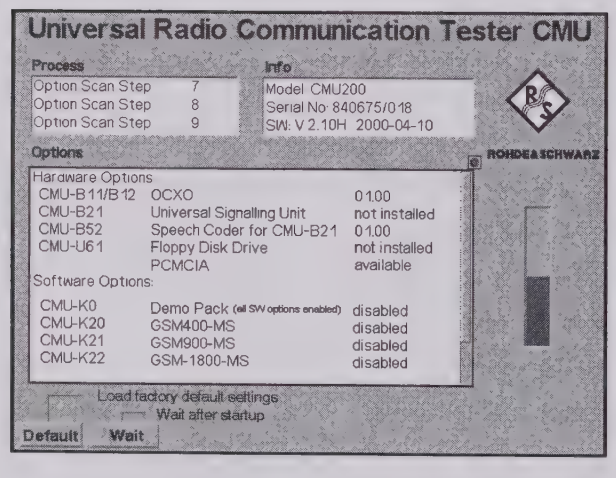
Numeric values can be either incremented/decremented using the rotary knob or entered via the numeric keypad.

Startup of the CMU

This chapter describes how to customize the CMU and perform simple RF measurements. As a prerequisite for starting the session, the instrument must be correctly set up and connected to the AC power supply as described in chapter 1.

Step 1

- Switch on the CMU using the mains switch at the rear. ①
- Check the operating mode of the instrument at the *ON/STANDBY* key on the front panel. If the CMU is in standby mode, press the *ON/STANDBY* key. ②



Step 2

The CMU is booted and after a short while displays the startup menu. This menu is usually closed as soon as the instrument software is loaded and the startup test is finished. ③

- Press the *Wait* hotkey to prevent the instrument from switching to another menu. ④

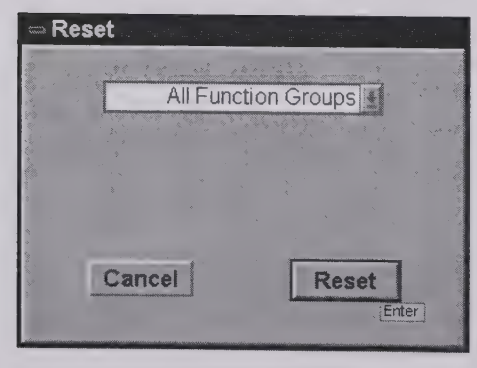
The *Wait* hotkey changes to *Cont.* with the additional message *Change to last menu* displayed on top.

- Press the *Cont.* hotkey to resume the startup process.

Step 3

- Press the *RESET* key.

The *Reset* popup menu is opened.



- Use the left and right arrow keys to toggle between the two buttons *Cancel* and *Reset*.
- Select *Reset* and press the *ENTER* key.
- In the popup window opened, select *Yes* to confirm the instrument reset.

The CMU indicates that it performs a general reset of all device settings and is then ready to carry out the following steps. The *Reset* popup menu is closed automatically.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① Mains switch on the rear panel

When the mains switch at the rear is set to the *O* position, the complete instrument is disconnected from the power supply. When the mains power switch is set to the *I* position, the instrument is in standby mode or in operation, depending on the position of the *ON/STANDBY* key on the front panel.

☞ chapter 1

The CMU is automatically set to the AC supply voltage and frequency applied. Note the permissible ranges of AC voltages and frequencies indicated at the rear of the instrument and in the data sheet.

☞ chapter 1

② ON/STANDBY key on the front panel

The *ON/STANDBY* key at the front of the instrument determines whether the instrument is in standby mode or in operation.

Standby mode:
Only the OCXO reference frequency oscillator (option CMU-B11/B12), if installed, is supplied with operating voltage. The orange LED (STANDBY) is illuminated.

Operation:
The green LED (ON) is illuminated and all modules of the instrument are supplied with operating voltage.

... on Step 2

③ Startup menu

The startup menu displays the following information:

- the status of the startup test *(Process)*,
- the device name, serial number and software version *(Info)*,
- the options and equipment installed *(Options)*,
- the progress of the startup test (*Startup* bargraph).

☞ chapter 4, p. 4.1

The *Default* hotkey can be used to load the factory default settings for all function groups. Settings made and stored in the previous session are overwritten.

④ Wait hotkey

By default the CMU switches to the last main menu of the previous session after terminating the startup process. This is convenient if an interrupted session is to be resumed or if the instrument is generally used in a definite operating mode.

On the other hand, the *Wait* function can be used to access the configuration menus which can be opened by means of the front panel keys before the actual measurement is started.

While the *Wait* hotkey is active, a reset of the instrument is not possible.

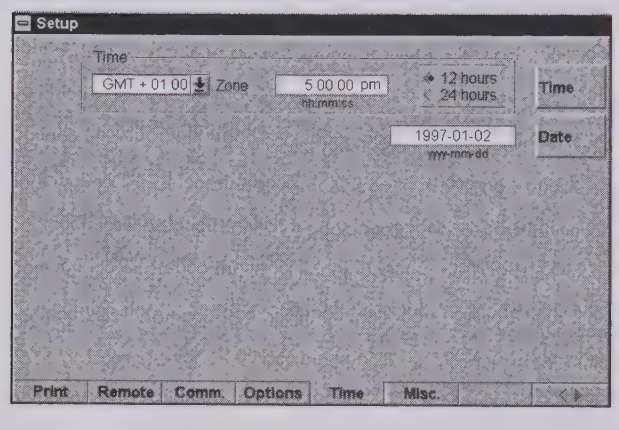
The CMU's user interface has been optimized with the aim of facilitating fast and easy switch-over between the menus and measurement modes. This includes the general configurations which can be accessed from any measurement menu.

The most important selection and configuration menus such as *Reset, Setup, Menu Select* are directly accessible via front panel keys.

Step 4

➢ Press the *SETUP* key to access general device settings.

➢ Press the *Time* hotkey to switch over to the *Time* index card of the *Setup* menu. ①



Step 5

The *Time* index card of the *Setup* menu displays the current time zone, time and date. ②

➢ Press the *Time* softkey to modify the settings for the current time.

➢ Use the left ⇨ and right arrow keys to access the three control elements.

➢ After selecting the *Zone* pull-down list, turn the rotary knob to expand the list and select one of the entries.

➢ After selecting the time input field press the *ENTER* key to edit the hours, minutes and seconds separately.

➢ After selecting the *12 hours/24 hours* command buttons use the rotary knob to switch over between European and North American time conventions.

Additional Information...

Alternative Settings and Measurements

... on Step 4

① **Softkeys and hotkeys**

Softkeys and hotkeys are activated by pressing the associated keys on both sides and across the bottom of the display. The general purpose of softkeys is to provide settings, control the generator and the measurements. Hotkeys are used to switch over between different menus and different index cards belonging to a popup menu.

☞ chapter 3

... on Step 5

② **Setup menu**

The *Setup* menu comprises several index cards providing general instrument settings. It is advisable to check and adjust the factory settings when you operate the CMU for the first time.

To switch over between the index cards of the setup menu use the hotkeys displayed at the bottom of the display.

☞ chapter 4, p. 4.5

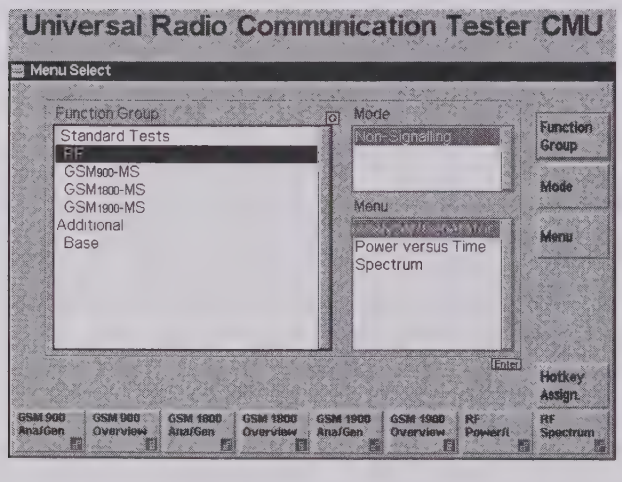
The different types of menus and control elements of the graphical user interface is explained in chapter 3. In the same chapter you can find a short tutorial on the entry of numbers and characters.

RF Non Signalling Measurements

In the *RF Non Signalling* mode, a continuous or pulsed RF signal can be generated and a RF signal with definite frequency characteristics can be analyzed. The signal level can be plotted in oscillographical *(Power vs Time)* or spectral *(Spectrum)* representation.

Step 1

➢ Press the *Menu Select* key to open the *Menu Select* menu.①



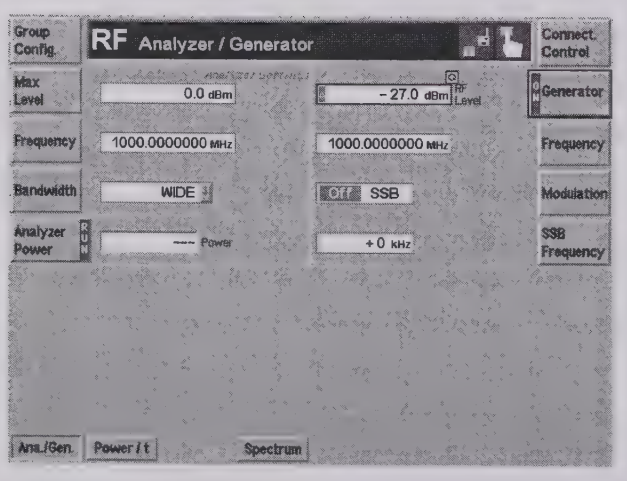
➢ Press the *Function Group* softkey and use the rotary knob to select the *RF* function group.

The *Non Signalling* mode is indicated and highlighted in the *Mode* field.

➢ Press the *Menu* softkey and use the rotary knob to select the *Analyzer/Generator* menu.

➢ Press the *Enter* key to activate the measurement selected and open the *RF Analyzer/Generator* menu.

Step 2



The *Analyzer/Generator* menu indicates the parameters of the signal generated and those of the signal received and analyzed by the CMU. ②

At present, all parameters are set to factory default values. They can be changed directly in the *Analyzer/Generator* menu. User-defined parameters will be saved for later sessions when the CMU is switched off.

➢ Select the *Generator* softkey by pressing once.

➢ Press the *ON/OFF* key to switch the RF generator on and off again. ③

➢ Set the generator frequency equal to the analyzer frequency as shown in the figure.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① Menu Select menu

The *Menu Select* menu shows all function groups installed on your CMU. If a function group is selected the corresponding modes and measurement menus are indicated. Function groups representing digital network tests (such as GSM900/1800/1900-MS) are generally subdivided in the two measurement modes *Non Signalling* and *Signalling*, each containing a number of measurement menus.

RF measurements are performed in the *Non Signalling* mode with the three measurement menus *Analyzer/Generator*, *Power vs. Time* and *Spectrum*. All three measurement menus can be directly accessed from the *Menu Select* menu.

☞ chapter 4, p. 4.3

For digital network tests refer to the relevant operating manuals. e.g. GSM900/1800/1900-MS.

... on Step 2

② Analyzer/Generator menu

The *Analyzer/Generator* menu contains two configuration panels used for

- control of signals received and analyzed by the CMU *(Analyzer Settings*, left side of the menu),
- control of signals generated *(Generator*, right side).

Defining a level and frequency in the *Generator* panel implies that a continuous signal with this level and frequency is generated.

The *Max. Level* defined in the *Analyzer* panel, however, denotes the maximum input power which can be measured. At the same time, it defines the upper limits of the *Power vs Time* diagram (see below). The permissible range of *Max. Level* depends on the input connector and external attenuation used (see section *Input Level* in chapter 4).

Defining a (center) frequency in the *Analyzer Settings* panel implies that only signals around this frequency are analyzed.

The *Bandwidth* softkey defines the resolution bandwidth of the analyzer.

☞ chapter 4, p. 4.13

The *Generator* panel is equivalent to the *Signal* tab of the *Connection Control* menu.

The *Generator* softkey opens the *Generator Configuration* popup menu providing further signal settings.

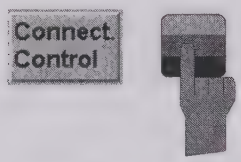
③ The status of the *Analyzer Power* measurement and of the RF Generator is shown besides the corresponding softkeys. For ongoing measurements, the result in the *Analyzer Power* output field is constantly updated.

At present no input signal is available so that the *Analyzer Power* output field shows no result "– – –"

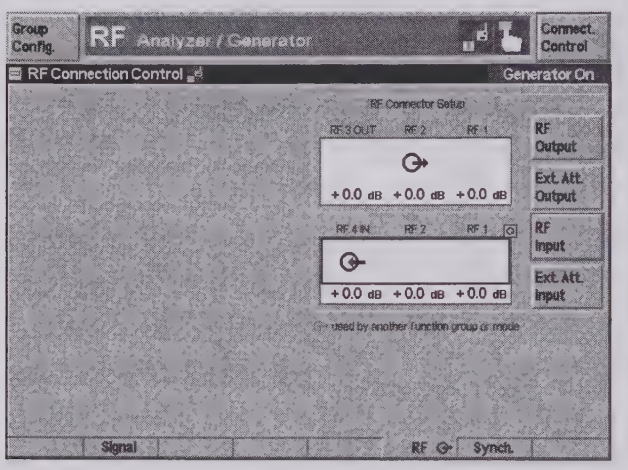
Once selected, the *Analyzer Power* measurement is switched off and on again by means of the *ON/OFF* key. In contrast, the *CONT/HALT* toggle key stops the measurement only after a valid result could be obtained.

☞ ch. 4, p. 4.14 and ch. 5

The options for the measurement status are *ON, OFF, or HLT*. The *HLT* applies particularly to single shot measurements (see the section about measurement control in chapter 5).



➢ Press the *Connect. Control* softkey.



Step 3

The *RF Connection Control* menu is opened. ①

➢ Press the *RF* ⊶ hotkey to open the index card defining the signal connectors and external attenuations.

➢ Select RF2 as output connector, RF4 IN as input connector. Do not define any external attenuations (all values equal to 0.0 dB).

Two yellow LEDs on the front panel indicate the input and output connectors selected.

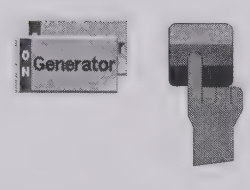
➢ Use a coax cable to connect RF2 to RF4 IN.

➢ Press the *ESCAPE* key to close the popup menu and return to the *RF Analyzer/Generator* main menu.

➢ In the main menu, press the *Max. Level* softkey and set the maximum input level to 20 dBm.

➢ Switch on the RF Generator.

The RF level measured is indicated next to the *Analyzer Power* softkey. Due to the loss in the signal path it can be slightly below the generator power selected. ②



➢ Press the *Generator* softkey twice.

The *Generator* Configuration popup menu is opened.

➢ Select the *Hopping* index card, use the rotary knob to select the *Ramping* parameter, press *Enter* and use the rotary knob again to switch the power ramping *ON*.

Now the generator transmits a pulsed (instead of a continuous) signal.

➢ Press the *Generator* softkey again or the *ESCAPE* key to close the popup menu.

Additional Information...

... on Step 3

① RF connectors

The *RF Connection Control* menu configures the input and output connectors in the *RF* function group. The four connectors on the front panel differ by their permissible range of input and output powers (see chapter 4 and data sheet). The values quoted on the left side are compatible with the rated specifications.

② External attenuation

An external attenuation can be reported to the CMU in order to compensate for known losses between the signal source and the device under test or the analyzer.

In our example, the (positive) difference between the analyzer power measured and the generator power can be reported as an external output attenuation at RF 2. The RF generator increases its level to maintain the commanded power of –27 dBm at the analyzer. The nominal generator power set in the RF level field is thus measured and indicated next to the *Analyzer Power* softkey.

Alternative Settings and Measurements

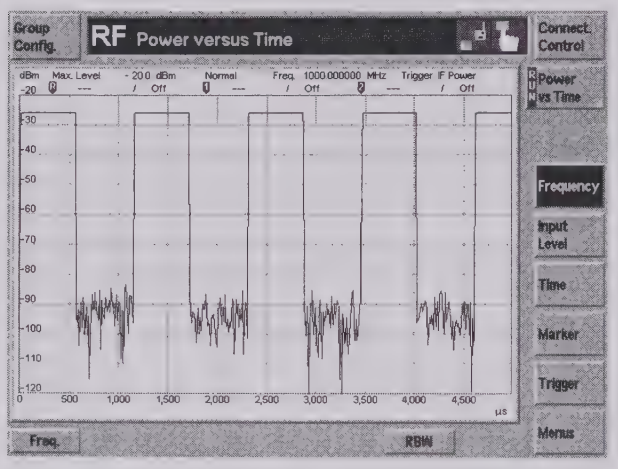
☞ chapter 4, p. 4.36

Settings made in *the Group Config.* and *Connect. Control* menus apply to the entire function group *RF Non Signalling*.

☞ chapter 4, p. 4.37

Note that an external attenuation reported to the CMU shifts the nominal permissible ranges of input and output levels.

Power/t



Step 4

➢ Press the *Power/t* hotkey to switch over to the graphical menu *Power vs Time*.

The *Power vs Time* menu shows the RF signal power measured as a function of time at a particular frequency and resolution bandwidth. An appropriate trigger condition must be selected to obtain a stable display. ①

Settings (default settings or the ones made in the *Analyzer/Generator* menu) and scalar results are displayed in two parameter lines above the diagram.

Various tools allowing to take a closer look at the measurement results are provided in the graphical measurement menu. ②

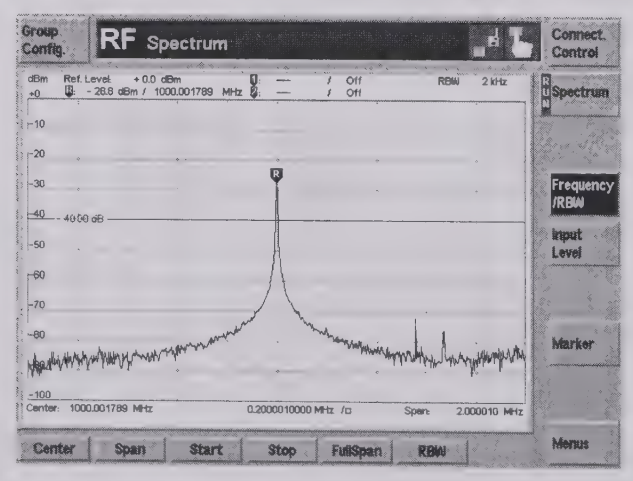
➢ Press the *Time* softkey and vary the *Span* to display several pulses in the diagram.

➢ Press the *Frequency* softkey and vary the resolution bandwidth (hotkey *RBW*). ③

➢ Press the *Menu* softkey to display the hotkeys used to change over to the other measurement menus.

➢ Press the *Spectrum* hotkey to switch over to the graphical menu *Spectrum*.

Spectrum



Step 5

The *Spectrum* menu shows the signal power in spectral representation, i.e. as a function of the frequency.

The settings and results displayed in the two parameter lines above the diagram are analogous to the ones shown in the Power vs Time menu.

➢ Press the *Marker* softkey and use the *R to Pk* and the *Cnt to R* hotkeys to center the diagram. ④

➢ Press the *Frequency/RBW* softkey to scale the diagram and adjust the resolution bandwidth.

➢ To close your session set the CMU to standby mode using the power switch on the front panel or use the mains switch at the rear.

Additional Information...

... on Step 4

① Trigger mode

The trigger mode is set in the *Group Configuration* popup menu or via the *Trigger* softkey in the graphical measurement menus. With the default setting *Free Run* the measurement is not synchronized to the frequency of the incoming pulses: The trace is permanently shifted in horizontal direction.

To show a signal consisting of rectangular pulses (bursts) it is recommended to trigger by either the rising or falling edge of the IF power.

② Markers

Markers are a graphical tool used to locate points on a trace and read out their coordinates. A reference marker and two delta markers may be defined in the *Power vs Time* menu.

The reference marker R measures the absolute level of the trace, the delta markers 1 and 2 measure the distance between their position and the reference marker. All marker coordinates are shown in the two parameter lines above the diagram.

③ Resolution bandwidth

A spectrum analyzer can differentiate two spectral lines separated by a minimum distance corresponding to the bandwidth of the resolution filter.

The smaller the bandwidth the better the resolution and the larger the signal-to-noise ratio. If the resolution bandwidth is too large only the envelope of the spectrum can be measured.

In the *Power vs Time* measurement, the signal-to-noise ratio improves but the time resolution **deteriorates** when the resolution bandwidth is reduced.

... on Step 5

④ Scaling of the spectral diagram

The tools provided in the *Spectrum* menu are particularly suitable for scaling a spectral diagram with a sharp main lobe and symmetric, lower side lobes:

- The *R to Pk* hotkey (*Marker* softkey) places the reference marker to the maximum (i.e. the main lobe) of the diagram.
- The *Cnt to R* hotkey (*Marker* softkey) centers the diagram to the frequency of the main marker.
- Equivalently, the *Center* hotkey *(Frequency/RBW* softkey) can be used to center the diagram.

Alternative Settings and Measurements

☞ chapter 4, p. 4.34

The *Frequency* softkey defines the frequency of the measured signal and the resolution bandwidth. The *Input Level* softkey configures the input level, the power range and an attenuation factor. The *Time* softkey configures the time axis.

☞ chapter 4, p. 4.19

In addition to markers, a D-line can be used to measure a particular level in the diagram.

☞ chapter 4, p. 4.19

☞ chapter 4, p. 4.25

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3 Manual Operation

This chapter provides a survey of the CMU's operating concept. This includes a description of the basic menu types, the selection and setting of parameters, and a general discussion of measurement control. The operating menus in the CMU basic system, the *RF* function group, and optional function groups are presented in an overview at the end of this chapter and described in greater detail in chapter 4.

Operating concept The CMU was designed for easy, intuitive operation. All menus rely upon a limited number of controls with analogous or identical function. Basic settings are discussed in section *Measurement Control* on page 3.17 and in chapter 5.

Basic elements The CMU is operated via softkeys and tables. Softkeys provide a fast access to the instrument functions. Tables facilitate the management of larger amounts of data.

Flexibility and uniformity The CMU permits to switch over between various operating modes (multi-mode operation). For this purpose, it is possible to change between the menus in almost any instrument state. The different function groups (*RF, GSM900/1800/1900* etc., see also separate operating manuals for network test applications) can be operated in the same way; measurements of the same type belonging to different applications are standardized.

Controls

The CMU is operated under menu control via keys, softkeys and hotkeys:

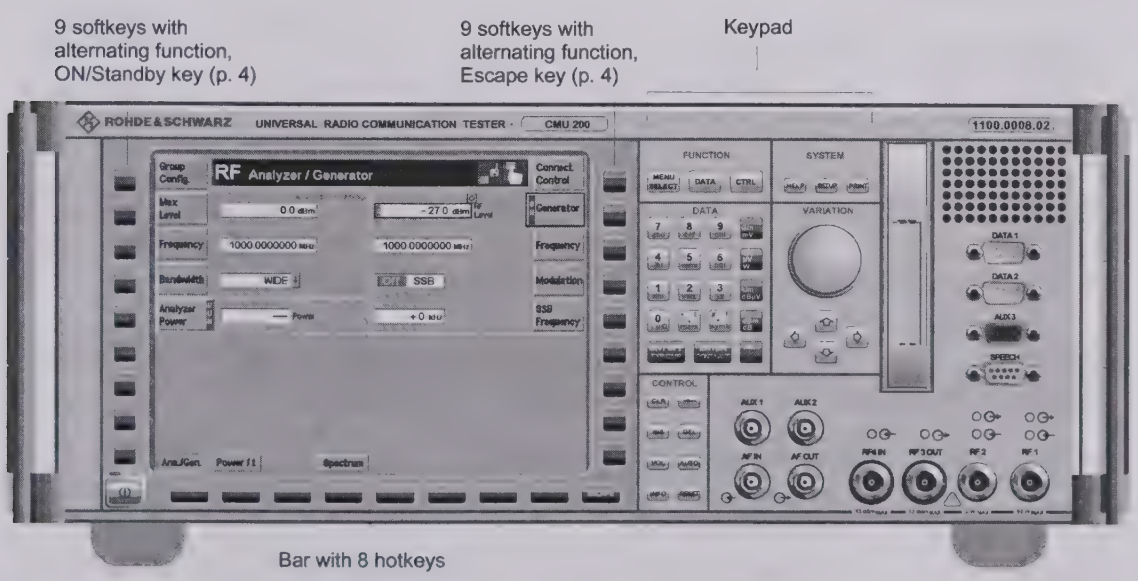


Fig. 3-1: Keys, softkeys and hotkeys

Rotary Knob

The rotary knob (spinwheel) can be used in two different ways:

- It is turned to select entries in list fields and tables and to vary (increment/decrement) numerical and alphanumerical entries.
- It is pressed to expand or compress table sections (thus replacing the *ON/OFF* key), to expand pull-down lists, to open auxiliary input fields, and to confirm numerical entries or selections (thus replacing the *ENTER* key).

Keys

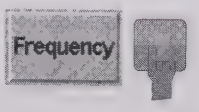
The keys located in the right-hand part of the front panel are combined to form groups according to their functions. They control

- Data input and variation
- Pre-selection of the menus
- Settings of the instrument, editor, help file and output

The keys are described with their function in chapter 1, section *Front and Rear View*.

Softkeys

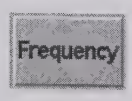
Softkeys are assigned to the nine keys located both at the left and at the right edge of the screen. To simplify the display, only the softkeys which are actually assigned in a menu are indicated (see menu example in Fig. 3-1).



Selection of softkeys:

The CMU provides selectable and non-selectable softkeys. A softkey is selected by pressing the associated key.

A selected softkey is highlighted by a blue frame. The selection establishes a connection to settings and functions related to the softkey. These related functions can be initiated via keys (e.g. *ON/OFF, CONT/HALT),* or via the selected softkey itself (e.g. calling up popup menus).

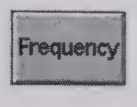


After the function has been terminated, or after another softkey is selected, the softkey returns to its initial state.

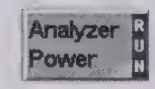
Softkey types and their function:

Softkeys perform functions within the corresponding menus. Different types of softkeys are provided:

- Pressing the softkey (i.e. the associated key) causes an immediate response on the screen. Examples are the non-selectable softkeys used to call up popup menus.

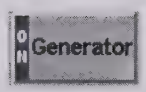


- Pressing the softkey activates a dialog box, e.g. an input field.



– The softkey indicates the measurement state (*RUN, OFF, HLT*). A yellow triangle indicates that a popup menu providing configurations can be opened with the softkey (press once for selection, a second time for opening the popup).

  A measurement can be started and aborted with the *ON/OFF* key (i.e. the ON/OFF key switches between the measurement states *RUN* and *OFF*). It can be stopped while preserving the valid results with the *CONT/HALT* key (i.e. the *CONT/HALT* key switches between the measurement states *RUN* and *HLT;* starting a measurement from the *OFF* state by means of the *CONT/HALT* key is not possible). In the *HLT* state, the instrument resources are not released; the application is still available. The formal aspects of measurement control are explained in chapter 5.

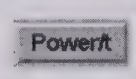


– The softkey indicates the generator status *(ON, OFF)*. A yellow triangle indicates that a popup menu providing configurations can be opened with the softkey (press once for selection, a second time for opening the popup).

  A generator can be started and aborted with the *ON/OFF* key. The formal aspects of generator control are explained in chapter 5, section *Measurement Control*.

Hotkeys

Hotkeys are assigned to the eight keys at the lower edge of the screen. Only the hotkeys softkeys which are actually assigned in a menu are indicated (see Fig. 3-1).



Selection:

A hotkey is activated by pressing the associated key. After activation it changes its frame.

Function:

Hotkeys permit to

– Change from one main menu/graphical measurement menu to the other

– Select tabs in the popup menu or table menu

In the graphical measurement menu (see page 3.6), hotkeys provide extended settings and can be used like ordinary function softkeys.

Operating Menus

The CMU offers a large variety of operating modes and applications. To ensure quick and easy operation, uniform menus have been implemented. They can be divided into three types:

Main menu Offers the main settings controlling a measurement and displays the main results,

Popup menu Provides extended settings for a main menu or function group,

Graphical menu Displays a measurement trace together with settings and further measurement results, contains softkeys and hotkeys used to access measurement control settings.

Main Menus

A main menu provides the basic settings controlling a measurement and at the same time displays the main results. Together with the graphical measurement menus, main menus constitute the basic level in the operating system of the CMU. They can only be replaced by other main menus or graphical measurement menus. To change the menu, the hotkeys at the lower edge of the main menu are used.

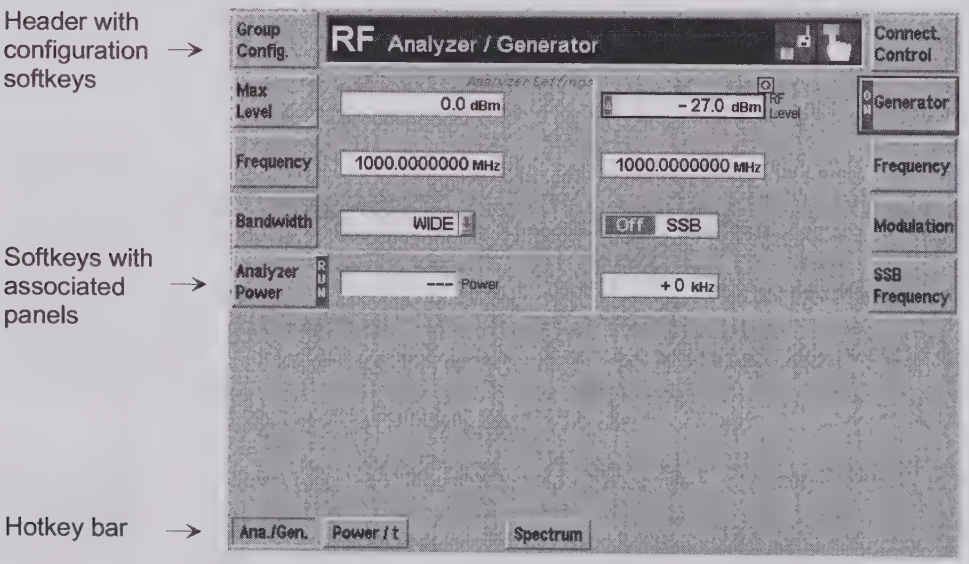


Fig. 3-2: Example of a main menu

Header The header consists of the heading and the symbols for the operating mode and signalling state.

- The *heading* briefly describes the menu subject (e.g. type of settings, measurement group, function group, etc.)
- The *operating mode*, i.e. the type of operation/control of the CMU, is indicated by the symbols at the right edge of the header. The following operating modes are available:

Manual mode

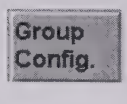
Remote control via IEC-bus

- The *signalling state* is indicated to the left of the operating mode:

Non signalling mode

Other *signalling states* are specific to the network test applications and discussed in the relevant manuals (e.g. *GSM900/1800/1900-MS).*

Test configurations

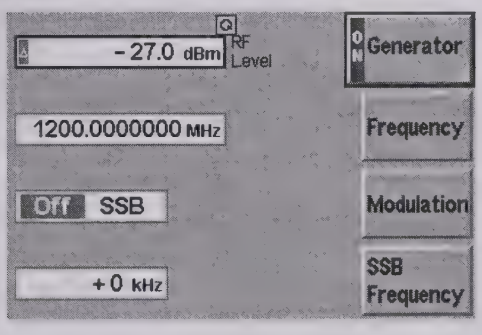


The *Group Config.* softkey is located to the left of the header of each main or graphical measurement menu. It opens a popup menu, which can be used for global configuration of the different measurements in the current *function group* and *signalling state*.

The *Connect. Control* softkey is located to the right of the header of each main or graphical measurement menu. It opens a popup menu, which is used to configure the inputs and outputs for the current *function group* and *signalling state* and further parameters such as network and signalling parameters (if applicable).

Softkeys with panels

A group of controls of a main menu with related function is generally combined in a panel.



A panel contains (at least) one softkey with associated input and display windows. The *main softkey* of a panel (if available) is the one that is located on top and displays the state of a measurement or a generator.

Hotkey bar

The max. 8 hotkeys at the lower edge of the main menu permit to change the menu. The hotkey bar is identical for all main menus within a function group so that blind operation is possible.

Graphical Measurement Menus

The CMU displays arrays of measurement results in the form of two-dimensional diagrams. In order to obtain additional space for the test diagram, the left softkey bar is suppressed. The right softkey bar can not always offer a sufficient number of functions and configurations, so the hotkeys are also used for menu operation. Further configuration settings can be accessed via popup menus.

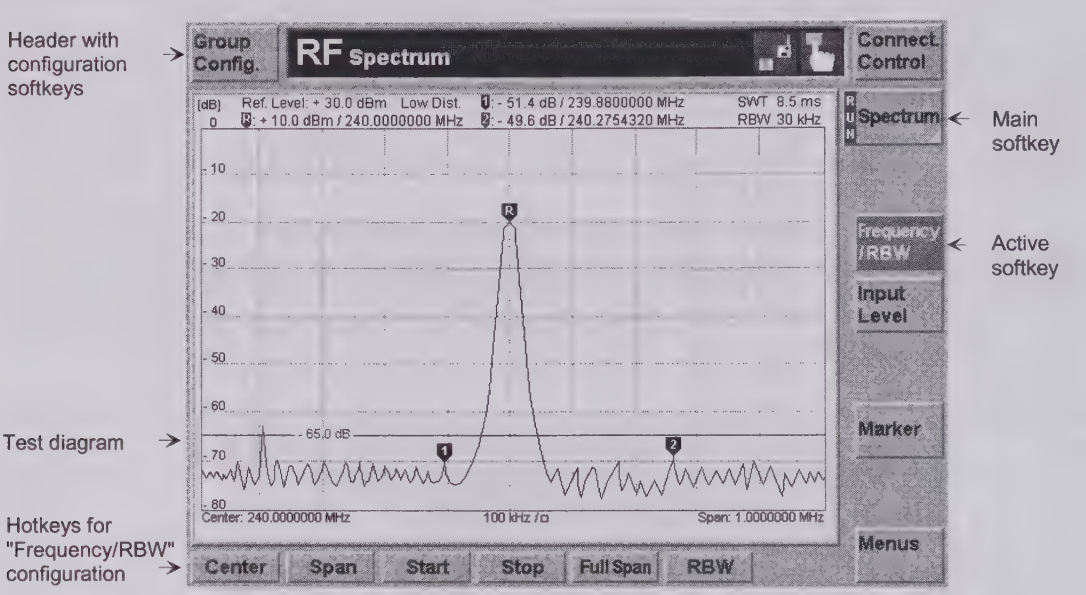


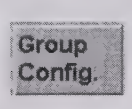
Fig. 3-3: Example of graphical measurement menu

Header

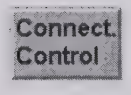
The header consists of the heading and the symbols for the function group and the signalling state.

- The *heading* briefly describes the menu subject (e.g. type of settings of the measurement, designation of the function group, etc.)
- The *signalling state*, i.e. the type of operation/control of the CMU, is indicated by symbols at the right edge of the header. See section *Main Menus* on page 3.4.

Test configurations



The *Group Config.* softkey is located to the left of the header of each main or graphical measurement menu. It opens a popup menu, which can be used for global configuration of the different measurements in the current *function group* and *signalling state*.

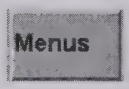


The *Connect. Control* softkey is located to the right of the header of each main or graphical measurement menu. It opens a popup menu, which is used to configure the inputs and outputs for the current *function group* and *signalling state* and further parameters such as network and signalling parameters (if required).

Softkeys

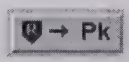
The main softkey of a graphical measurement menu is located directly below the *Connect. Control* softkey. Its labeling corresponds to the menu heading. The main softkey controls the measurement and indicates its state. In the example of Fig. 3-3 a popup menu is available for this purpose.

The function softkeys below the main softkey activate the associated hotkey bar. An active function softkey is displayed in inverse video.

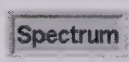


The *Menus* softkey changes the hotkey bar to the menu-changing mode.

Hotkeys



In the function mode, i.e. if one of the function softkeys is activated, the hotkeys below the test diagram provide sub-functions for the respective softkey.



In the menu-changing mode, i.e. if the *Menus* softkey is activated, the hotkeys change between the various measurement groups of the current function group.

Popup window

Popup windows are associated to all hotkeys that require the selection or input of parameters. These popup windows are operated like input fields in the main menus (input of numbers and characters) or list fields (selection between a range of alternative settings).

Popup Menus

Popup menus extend the functions of a main menu. They are available with the configuration softkeys *Group Config.* and *Connect. Control* as well as with all softkeys in a main menu that are marked by a yellow triangle at the bottom right. They may be divided into several tabs that are selected via hotkeys in the main menu.

The popup menus *Group Configuration* and *Connection Control* are activated by pressing the respective softkeys. Popup menus which configure a measurement are activated by pressing the respective softkey twice (selection of softkey and subsequent opening of popup menu). A popup menu is closed by means of the *ESCAPE* key or by pressing the calling softkey again.

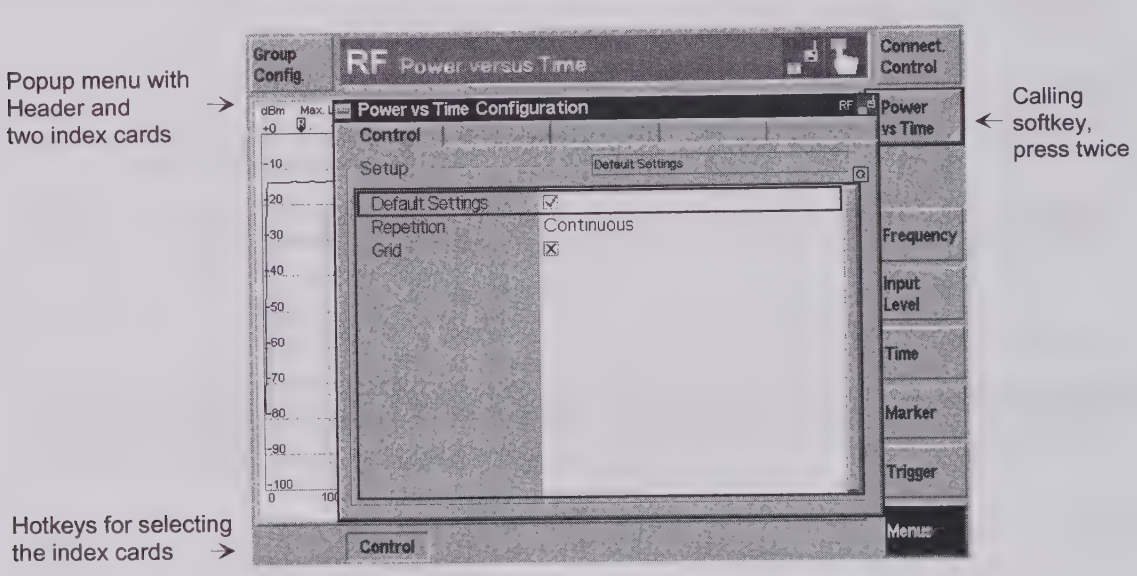


Fig. 3-4: Example of a popup menu

Header

The header consists of

- The heading (*<name of the measurement group> Configuration*; the function group is indicated on the right in small characters),
- The symbol for the signalling state on the right. See section *Main Menus* on page 3.4.

Tabs

Popup menus come without tabs (1 single window) or with several tabs (pages).

The tabs may contain input fields, select fields, command and on/off switches (checkboxes). Various fields can be combined to form groups (panels).

(Expanding) menu tables

Configuration settings in popup menus are often arranged in tables. If a table provides a large number of settings, these are usually grouped under several header lines marked by a black triangle. The items belonging to a group can be shown (expanded, triangle points down) and hidden (compressed, triangle points to the right) by selecting the corresponding header line and pressing the *ON/OFF* key.

Operation of Popup Menus

The following table provides an overview of the operation of popup menus.

Table 3-1: Operation of popup menus

Action	Operation via keys
Open menu	Press the softkey twice (selection plus opening of menu), press only once in the case of *Group Config.* and *Connect. Control*
Select tabs dialog elements	Press hotkey softkeys *(Connect. Control)*, cursor keys
Edit fields	Keys *ON/OFF, ENTER,* number and unit keys, rotary knob, see section *Dialog Elements in the Menu* on page 3.10.
Edit table entries	Keys ON/OFF, ENTER, number and unit keys, rotary knob, see section *Dialog Elements in the Menu* on page 3.10.
Quit and close menu	Any assigned softkey / *ESCAPE* key

Dialog Elements in the Menu

This section describes the various types of dialog fields and the procedure for the input of values and parameters.

Various input and select field types request a selection to be confirmed using the *ENTER* key. The cursor can be freely shifted over these fields; only after the confirmation is the setting transferred to the instrument software.

In the case of select fields without confirmation, settings are immediately made, they take effect with the cursor selection.

Input Fields

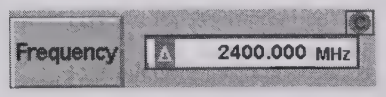
An input field (editor) is a white, rectangular area on the screen which permits numbers or characters to be entered. Input fields are available both in main and in popup menus. In graphical measurement menus, the input fields are popup windows which can be called up by means of hotkeys while the instrument is in the function mode.

Note: *The easiest and quickest way to enter numbers or characters is by means of an external keyboard that is connected to the* KEYBOARD *connector at the rear of the CMU (see chapter 1). Alternatively, follow the directions given in the next two sections.*

Input of Numbers

Input fields for numerical values are activated by pressing the respective softkey. Numerical values can either be varied using the rotary knob (by incrementing/decrementing individual digits) or directly entered via the numerical keypad *(DATA)* on the front panel or an external keyboard. To this end, the insert and overwrite mode is available. It may be necessary to confirm the input for transfer to the instrument hardware.

In the following, the most important possible inputs using the rotary knob or the numerical keys will be described.

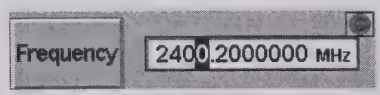


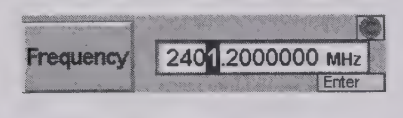
Activating an input field and a digit

➢ To activate the input field press the associated softkey.

The input field appears with a blue frame. The symbol for the rotary knob appears at the top right of the input field.

The input field is in start mode, indicated by a small white triangle on a gray background. From the start mode, it can be switched to either insert or overwrite mode.





Input using the rotary knob – Overwrite mode

➢ In the start mode, turn the rotary knob to activate the overwrite mode and vary the last digit of the current number.

➢ Use the left or right *arrow key* to switch between the decimal places of the indicated number.

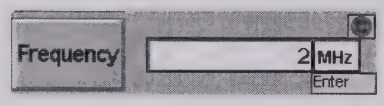
➢ Increment/decrement the active digit by turning the *rotary knob*.

The individual digits can be varied without restriction. Incrementing a "9" produces 0 and causes the next higher digit

to be incremented by 1. The editor behaves analogously when a "0" is decremented.

An *Enter* symbol at the bottom right of the input field indicates that the current value has yet to be written to the CMU software.

- Confirm the entry and terminate the input using the *ENTER* key or by pressing the rotary knob or another softkey or ...
- Press *ESCAPE* to discard the entry.



Input using the numerical keypad – Insert Mode

- In the start mode, type one of the number keys of the numerical keypad.

  The previous numeric value of the editor is completely replaced. The CMU changes to the insert mode characterized by a cursor symbol. Further digits are inserted to the left of the cursor.

- Entries made in insert mode via the numerical keypad must always be confirmed using the *ENTER* key or by pressing the rotary knob.

Further control keys

The keys of the *CONTROL* group extend the functions of numerical input.

- Use the INS *(insert)* key to change between the modes *insert* and *overwrite*.

  In the insert mode, the cursor appears in the input field.

- Use the ← *(backspace)* key to delete the character to the left of the cursor (in insert mode).
- Use the DEL *(delete)* key to delete the highlighted character (in overwrite mode) and the digit right from the cursor key (in insert mode).
- Use the CLR *(clear)* key to delete all characters.

Confirming/discarding the input

The behavior of the editors depends on whether the values were entered in the insert or in the overwrite mode:

- If only the overwrite mode was used to define the input value no confirmation is necessary. The input value is valid as soon as another softkey or hotkey is pressed.
- If the insert mode is used, or if it was used before swapping over to the overwrite mode, the input must be confirmed with the *ENTER* key or by pressing the rotary knob. By pressing *ESCAPE* or another softkey, the input will be discarded and the previous value restored.

If the number entered conflicts with the resolution of the CMU, it will be rounded to the maximum number of digits allowed.

Error message during input

If the value defined in the input field is too high or too low, a window with the error message „*<numerical value> is out of range. <permissible maximum value> is limit.*" will appear together with three buttons:

Accept	Permissible maximum value accepted for input field,
Re-edit	New entry
Cancel	Last valid input value is retained.

Input of alphanumerical characters

Input fields for alphanumerical characters are activated by pressing the respective softkey. Characters can be either varied using the rotary knob (by variation of individual characters in alphabetical order) or entered via the numerical keypad *(DATA)* on the front panel or an external keyboard. The input must be confirmed using the *ENTER* key in order to be transferred to the instrument hardware. The input is terminated upon confirmation.

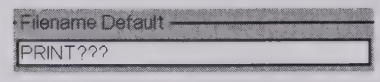
The table below shows the assignment of the numerical keys.

Table 3-2: Assignment of numerical keys and alphanumeric characters

Key	Character (upper case)	Character (lower case)
7 abc	A B C 7 Ä Æ Å Ç	a b c 7 ä æ å ç
8 def	D E F 8 É	d e f 8 é è
9 ghi	G H I 9	g h i 9 ì
4 jkl	J K L 4	j k l 4
5 mno	M N O 5 Ñ Ö	m n o 5 ñ ö ò
6 pqr	P Q R 6	p q r 6 ß
1 stu	S T U 1 Ü	s t u 1 ü ù
2 vwx	V W X 2	v w x 2
3 yz	Y Z 3	y z 3
0 _µΩ	space µ Ω 0 £ $ ¥ €	space µ Ω 0 £ $ ¥ €
. * mark	\ _ * , . : ; ' " ? ( )	\ _ * , . : ; ' " ? ( )
- # symb	- # / ( ) < = > % &	- # / ( ) < = > % &
UNIT..	Upper / lower case	Upper / lower case

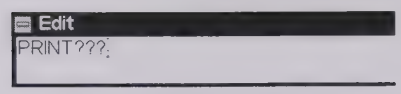
The full character set may be restricted if required for reasons of compatibility (e.g. for input fields defining file names).

The most important possible inputs using the rotary knob or the digital keys are described in the following.



Activating the input field and auxiliary editor

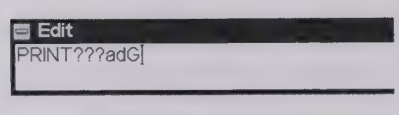
- To activate the input field press the associated softkey. If the softkey is assigned to a panel with several controls, use the cursor key to select the desired input field.



- Press or turn the rotary knob to open the auxiliary editor associated to the input field.

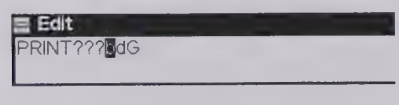
  The auxiliary editor is used to edit a name that may extend over several lines. The cursor is placed at the end of the current character string.

Input using the numerical keys



- Press one of the numerical keys to write a character to the current cursor position.

- To change a character, position the cursor to the desired character using the left or right *arrow key* and overwrite the character.

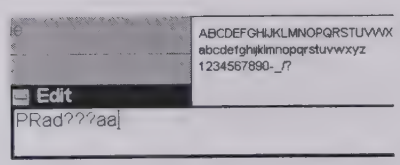


- Press a numerical key repeatedly to access the different characters assigned to it (see assignment of keys in Table 3-2).
- Press the *UNIT* key plus a numerical key to switch to the upper case character set.
- Confirm the input using the *ENTER* key.

  If the syntax specified is invalid (e.g. an invalid file name was defined), an error message of the type *Filename syntax <name> is invalid Cancel / Re-edit* is displayed. Otherwise the edited character string is written to the input field in the menu.

- Press another softkey or change the menu to close the auxiliary editor.

Input using the rotary knob



- After opening the auxiliary editor, turn the rotary knob in either direction. A list of all valid (upper and lower case) characters for the current input field is opened.
- Turn the rotary knob and select the character to be written to the cursor position in the auxiliary editor. Selected characters are shown in inverse video.
- Press the rotary knob to confirm your selection and enter the selected character into the auxiliary editor.
- Select a character and turn the rotary knob to increment/decrement the character in alphabetical order.

Insert/overwrite

The keys of the *CONTROL* group extend the functions of character input.

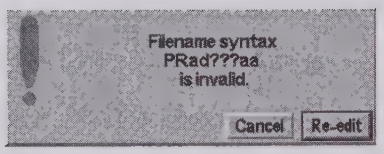
- Use the INS *(insert)* key to change between the modes *insert* and *delete*.

In insert mode, the cursor appears in the input field.

- Use the ← *(backspace)* key to delete the character to the left of the cursor.
- Use the DEL *(delete)* key to delete the inversely displayed character (in overwrite mode).
- Use the CLR *(clear)* key to delete all characters.

Confirming/discarding the input

- Use the ESCAPE *(ESCAPE)* key or another softkey to abort character input and deactivate the input field and the softkey.
- Use the CONT/HALT *(ENTER)* key to confirm the character input.



If the syntax specified is invalid (e.g. an invalid file name was defined), an error message of the type *Filename syntax <name> is invalid Cancel / Re-edit* is displayed. Otherwise the edited character string is written to the input field in the menu.

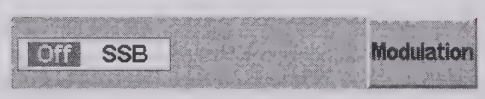
- Press another softkey or change the menu to close the auxiliary editor.

Select Fields

Various types of fields permit to select one or several settings out of a number of given options. The desired settings are to be marked; the selection is to be confirmed using the *ENTER* key, if required.

Select Fields in the Main Menu

Select fields in main menus are arranged in panels together with a softkey. Selection of the softkey activates the associated field for the selection.



Toggle switches (Loop Toggle)

Select one out of n (generally few) settings. The selected setting is shown in inverse video.

- Select the associated softkey to activate the toggle switch.
- To toggle between the settings use the rotary knob.

Pull-down lists

are marked by an arrow and select one out of n settings. The list of settings will appear in a pull-down window after the field is selected.

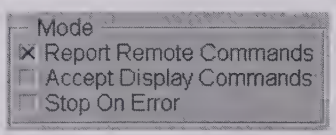
- ➢ Select the associated softkey to activate the select field and expand the list.
- ➢ To select one of the settings, use the rotary knob.
- ➢ Press *ENTER* to confirm your selection and close the list.
- ➢ Press *ESCAPE* or another key to discard your selection and close the list.

Select Fields in the Popup Menu

Popup menus may or may not contain softkeys; they contain input or select fields which can be combined to form panels or groups and tables. Select fields and tables in the popup menus can be controlled intuitively using the cursor keys . The following overview applies to all field types.

Table 3-3: Operation of select fields

Action	Key operation
Select field group / list	Cursor keys ⇦⇨⇧ , softkey
Select single field, command button, or line in list field or table	Rotary knob
Switch on or off single field or line in list field	*On/Off* key, in the case of buttons also rotary knob, *ENTER* key
Confirmation (if required)	*ENTER* key



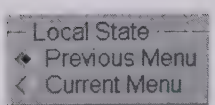
On/off buttons (on/off switches)

switch individual settings on or off.

- ➢ To select this field use the cursor keys ⇦⇨⇧ or the associated softkey (if available).

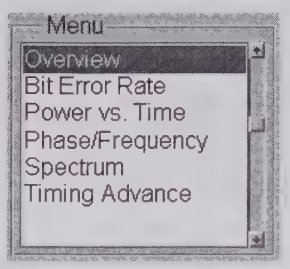
  A selected field is indicated by a blue frame.
- ➢ To switch the button on or off press the *On/Off* key (as an alternative use the rotary knob or the *ENTER* key, see Table 3-3).

Sometimes, editing of an on/off button is not possible in all measurement modes. If it cannot be set at the moment, it is grayed.



Command buttons (selection 1 out of n)

form groups offering a choice of settings which exclude each other. The individual settings can be selected with the rotary knob (cf. Table 3-3).

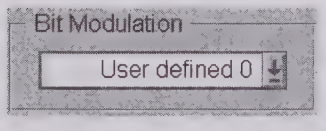


List fields (selection 1 out of n)

provide a choice of several text lines in a rectangular window:

- Select one out of several list fields using the cursor keys ⇦⇨⇧ .
- To select a line use the rotary knob. If a line beyond the edge of the list is to be selected, the whole list will be shifted (scroll function).

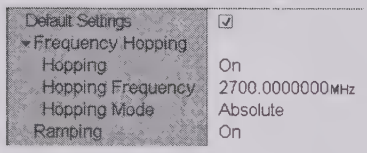
For operation of list fields see Table 3-3.



Pull-down list fields

are similar to the list fields described above as far as their function and operation is concerned; however, they are compressed into one line in the popup menu.

- Press the associated softkey (if available) or use the cursor keys ⇦⇨⇧ to select the list. Press *ENTER* or the rotary knob to expand the list (expand in upward or downward direction depending on the space available).
- To select a line use the rotary knob.
- Press *ENTER* to confirm your selection and close the list.
- Press *ESCAPE* or another key to discard your selection and close the list.



(Expanding) menu tables

usually cover the whole popup menu or tab so they are active as soon as the menu is opened. The right-hand fields of a menu table (white background) can be edited. Table lines without any input option but with a black triangle are headers with several sub-items that can be expanded or compressed:

- To move to a line use the rotary knob.
- Press *ENTER* to select a line and start editing. Numerical values can be entered as described in section *Input of Numbers* on page 3.10. Alternative settings can be selected using the rotary knob.
- Press *ENTER* to confirm an entry and release the table line.
- Press *ESCAPE* or another key to discard your entry and release the table line.
- Select a header line and press the rotary knob to expand (show) or compress (hide) a table section. Press the *ON/OFF* key to expand all compressed tables in the menu.

Measurement Control

This section gives a brief survey of the CMU's measurement control using the function group *RF Non Signalling* as an example. This includes a discussion of the different measurement modes and measured quantities. Settings and measurement parameters frequently encountered are explained from a general point of view.

The formal aspects of measurement control are discussed in more detail in chapter 5 *(Remote Control – Basics)*.

The menus of the graphical user interface can be arranged in different ways. According to their tasks, they form the following groups:

- The function groups *RF*, *Audio, GSM900-MS, GSM1800-MS* and *GSM1900-MS*, etc. The *RF* function group is supplied with the firmware for the CMU base system. The function groups for network test applications are optional and described in separate operating manuals.
- The two signalling modes *Signalling* and *Non Signalling*. The signalling properties are specific to the individual networks and devices under test. In the function group *RF* only *Non Signalling* measurements are provided.
- General configurations *(Group Configuration, Connection Control),* configurations specific to a measured quantity *(Power vs Time Configuration, Spectrum Configuration*, etc.), and menus displaying the results of the measurement *(Power vs Time, Spectrum* etc.).

In a more formal sense, the CMU uses main menus, popup menus, table menus, and graphical measurement menus and dialog windows of various size. This aspect is discussed in the preceding sections.

Configurations

The CMU offers a wide range of settings for input and output signals and measurements. Configurations either refer to the whole function group *(Group Configuration, Connection Control)* or to a particular measurement.

Group Configuration

The *Group Config.* softkey is located on the left side of the title bar of each main menu and graphical measurement menu. It opens a popup menu with several tabs configuring

- The CMU receiver settings *(Input Level)*
- The trigger mode *(Trigger)*

All settings made in the *Group Config.* menu apply to the whole function group and test (signalling) mode. Most of them can be overwritten, however, by means of the softkeys and hotkeys offered in the graphical measurement menus.

Connection Control

The *Connect. Control* softkey is located on the right side of the title bar of each main and graphical measurement menu. It opens a popup menu with several tabs configuring

- The RF generator
- The RF connectors to be used and the external attenuation
- The reference signal and system clock

All settings made in the *Connect. Control* menu apply to the whole function group and signalling mode.

Configurations of measurements

A popup menu offering specific settings is assigned to each measurement group *(Power vs. Time and Spectrum)*. The following parameters can be defined:

- The repetition mode and stop condition for the measurement
- Tolerances for the measured quantities
- Statistic count and display mode

Most of these settings are not needed in the device configuration menus and the *RF* function group discussed in this manual. For a detailed explanation refer to the manuals for network tests, e.g., *GSM900/1800/1900-MS*.

Measurement Groups

Measurement results are indicated in two different ways:

- Discrete (scalar) values and parameters are displayed in output fields, lists and tables.
- Traces are displayed in a Cartesian coordinate system, the time forming the x-axis scale.

While the measurement is running, the indicated results are constantly updated. Each function group and measurement mode comprises a particular selection of measurement groups. The measurement groups belonging to function group RF (Non Signalling) are shown in the following table.

Table 3-4 Measurements in function group *RF (Non Signalling)*

Menu	Function
Analyzer/Generator	Shows the settings for the signals generated and analyzed by the instrument, the generator status, and the state of the RF analysis. Moreover the current analyzer power is indicated.
Power vs Time	Shows the trace of the measured RF power in oscillographic representation, i.e. as a function of time. The maximum level and frequency of the input signal is indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line).
Spectrum	Shows the trace of the measured RF power in spectral representation, i.e. as a function of the frequency. Parameters of the measurement are indicated in addition. Single points of the trace may be evaluated using graphical tools (markers, D-Line).

A graphical overview of the menus is given at the end of this chapter.

Menu Overview

CMU Base System – General Configurations

On Start-up:

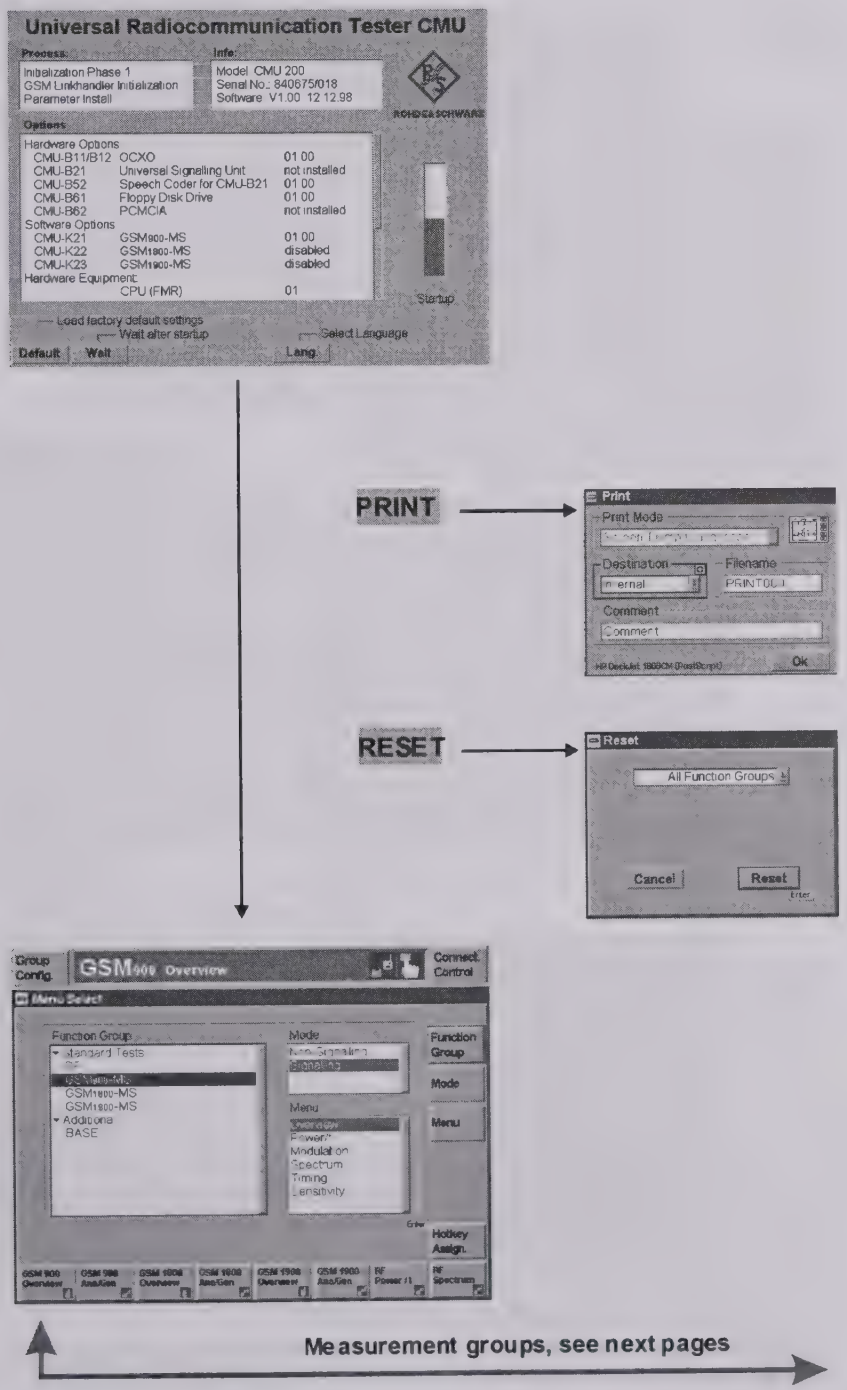


Fig. 3-5: CMU Base System – General Settings

CMU Base System – Setup

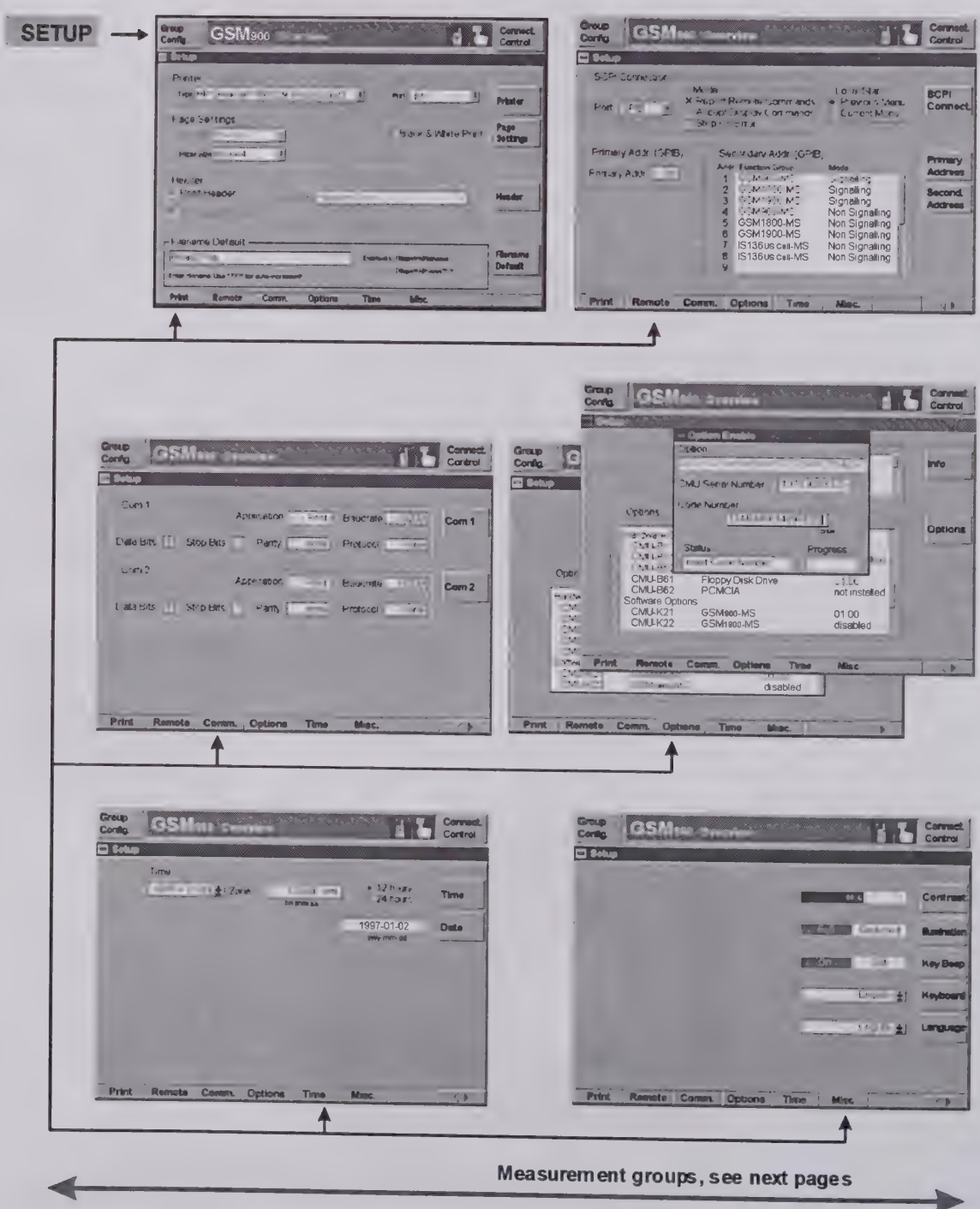


Fig. 3-6: CMU Base System – Setup

RF Measurements – General Configurations

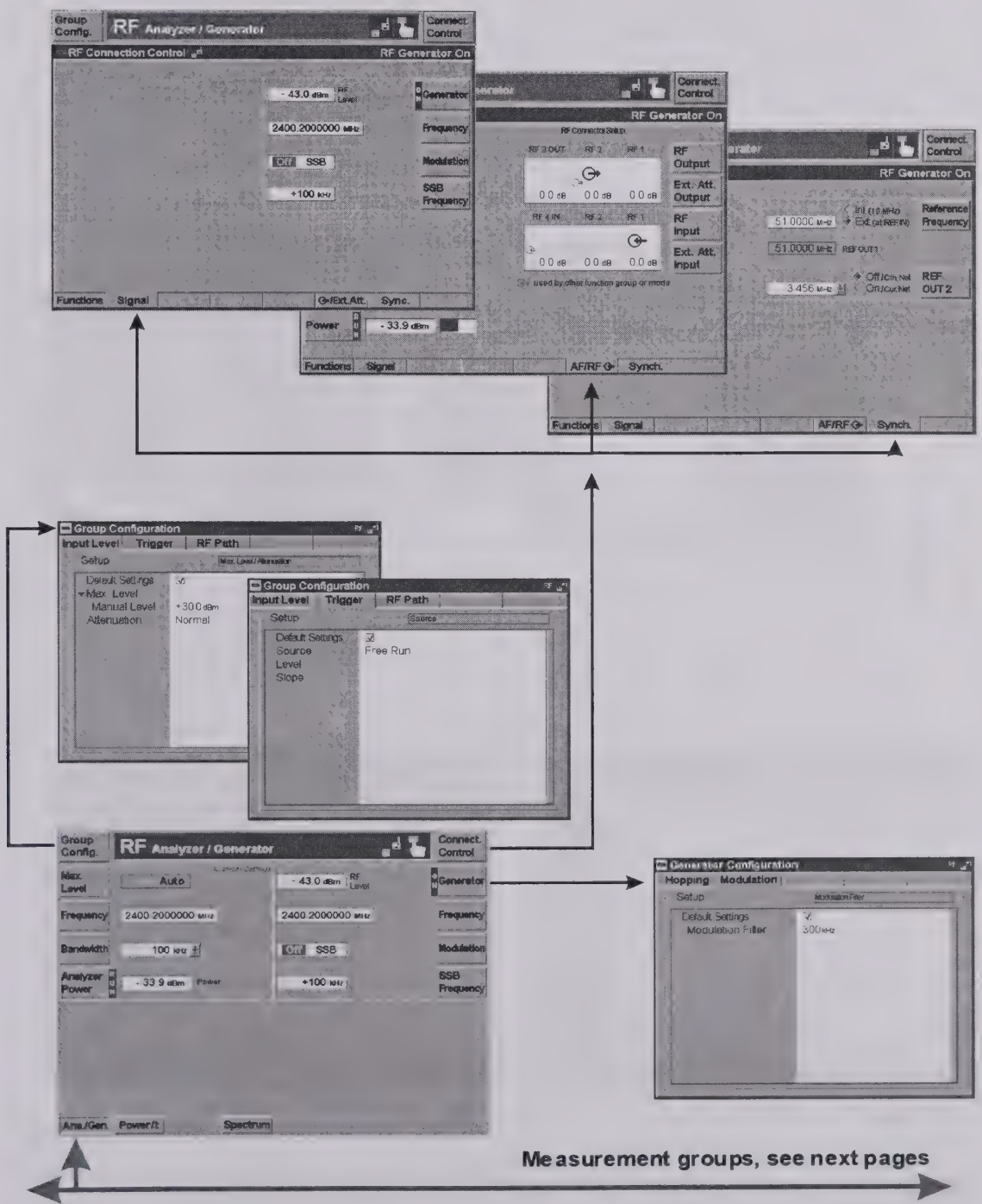


Fig. 3-7: RF Measurements – General Configurations

RF Measurements – Power and Spectrum

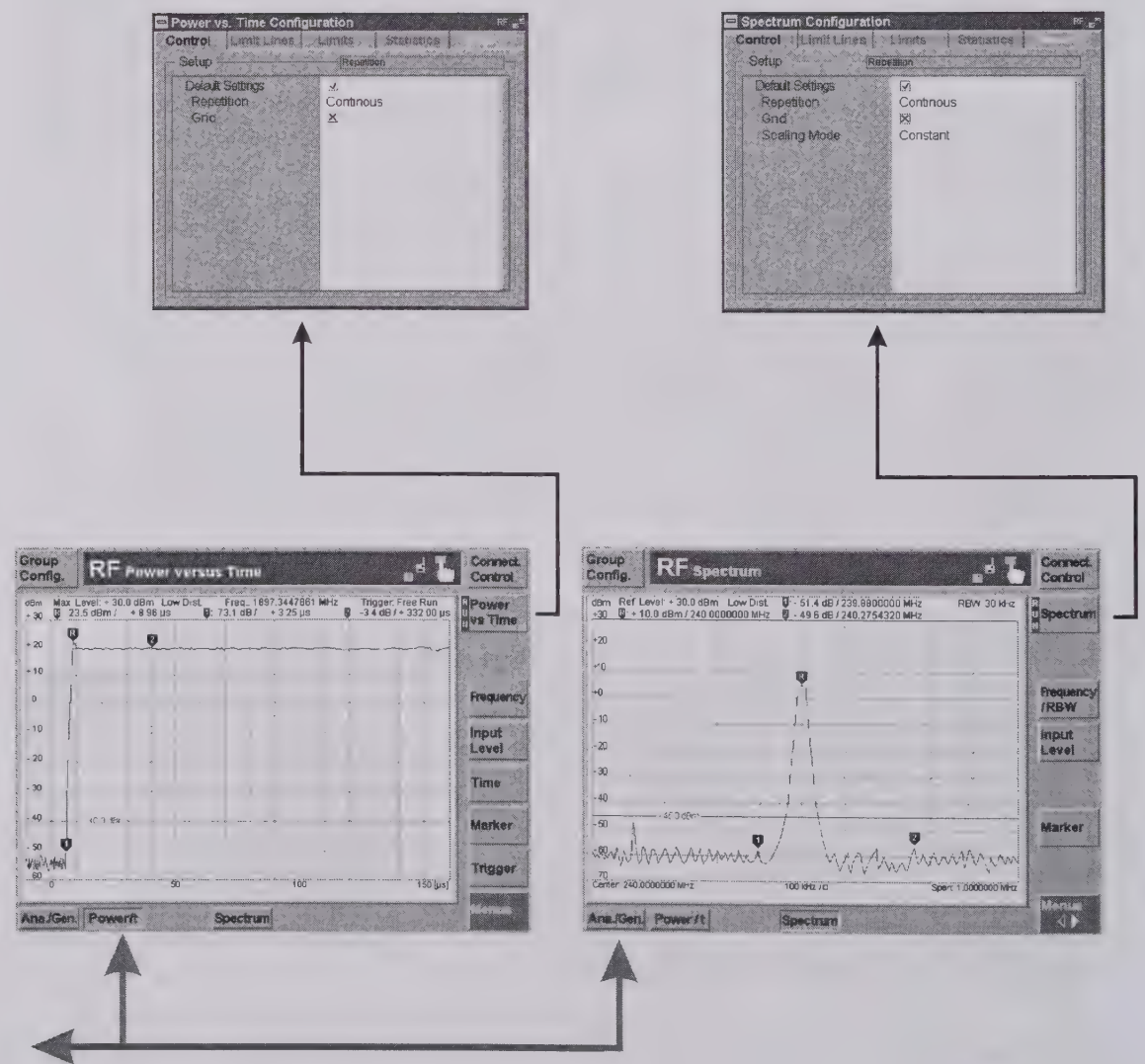


Fig. 3-8: RF Measurements – Power and Spectrum

Options: Audio Generator and Analyzer

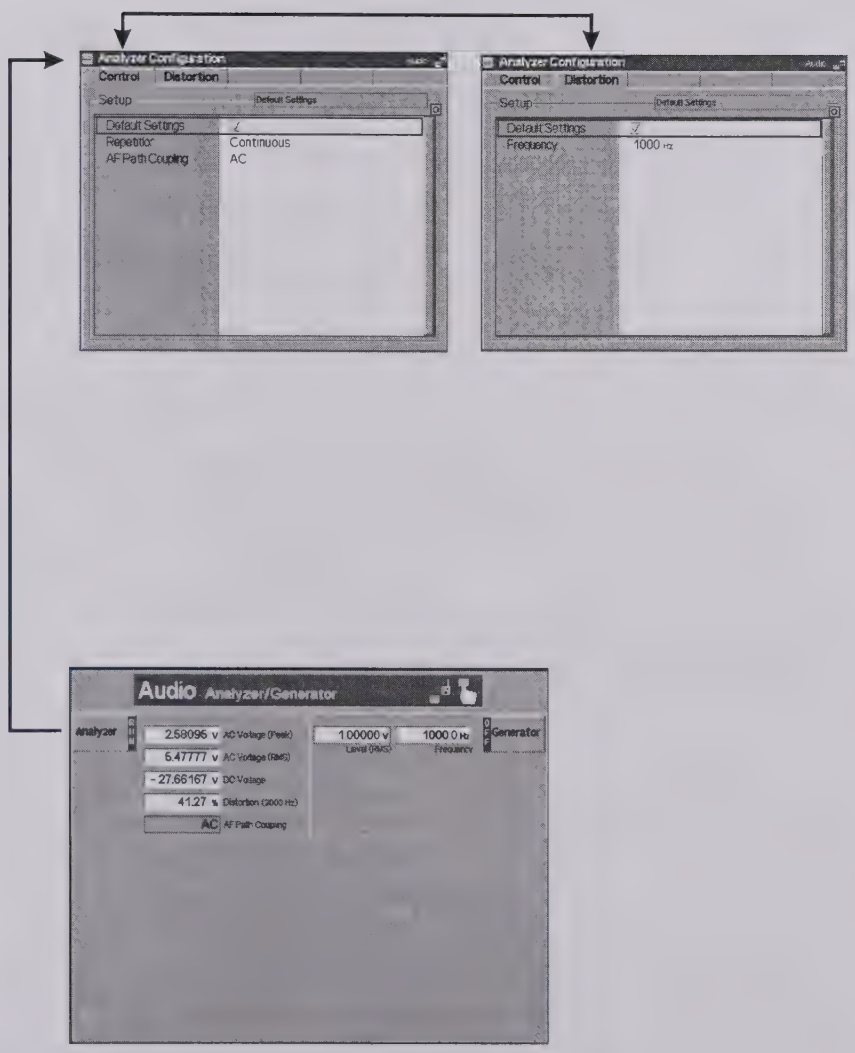


Fig. 3-9: Audio Generator and Analyzer

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4 Functions and their Application

This chapter explains in detail all functions of the CMU and their application. The structure of the chapter is based on the menu groups and their function. It is organized like a typical measurement session including the following stages:

1. Startup menu
2. Menu selection
3. General device configurations
4. RF measurements (measurements and measurement results, configurations)

In contrast to chapter 6, *Remote Control – Commands*, the measurement and results are explained first, special measurement configurations are relegated to the end of the chapter. The description of the softkeys is followed by the remote-control commands. Similarly, the description of the commands in chapter 6 also contains the corresponding menus of the user surface.

The description of the operating concept is to be found in chapter 3; besides, an overview of all menus is given at the end of chapter 3. To find information on a particular topic please refer to the index at the end of the manual.

Startup Menu

The startup menu provides information on the instrument and the installed options. It appears for a few seconds in the display after switching on the CMU and activating the operating mode (see section 1, *Switching on the Instrument/Startup Test*). During display of this menu, the CMU performs a startup test.

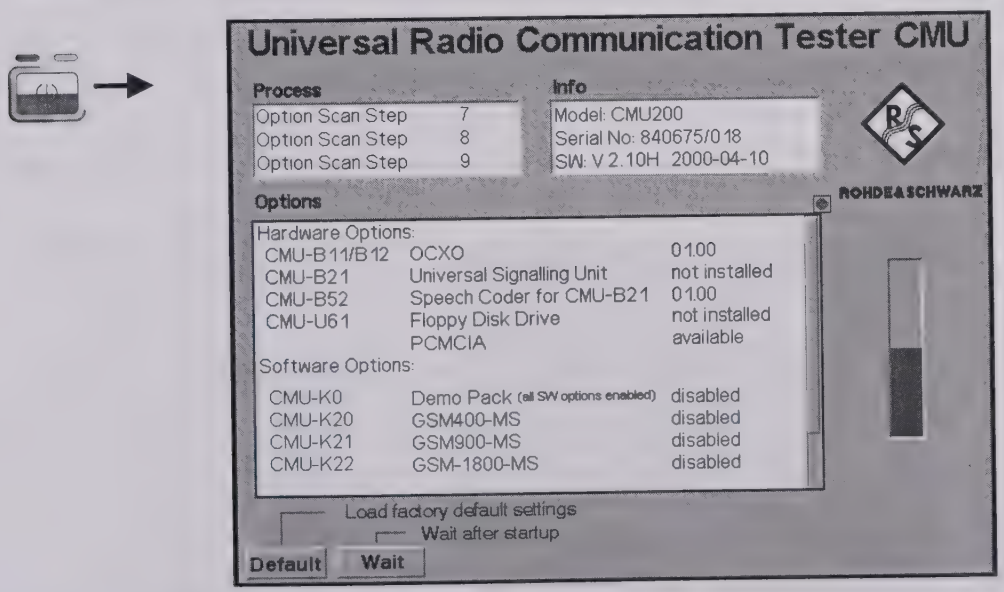


Fig. 4-1 Startup menu

Displays in the startup menu

The display windows of the startup menu provide information on

- the startup procedure (*Process*),
- instrument model, serial number and software version *(Info)*,
- installed options and accessories *(Options)*,
- progress of the startup procedure (*Startup* bargraph).

After the startup procedure has been terminated, the instrument changes to the last main menu or graphical measurement menu of the previous session.

Options

All the options of the CMU are listed in the section "Installation of Options (Setup – Options)" in this chapter.

Further information on the options is to be found in the data sheet. Installation and removal of options is described in chapter 4 of the service manual.

Hotkeys

During the startup procedure, the hotkeys of the startup menu are available.

Default

The *Default* hotkey activates the default settings of the instrument.

Wait

The *Wait* hotkey prevents the instrument from closing the *Startup* menu.

As a result of this, the *Wait* softkey changes to *Cont.* with the additional message *Change to last menu* displayed on top. Instead of changing to the last main menu or graphical measurement menu of the previous session the measurement can be continued by pressing a key *(Menu Select, Setup, ...)*.

Reset of Instrument Settings (RESET Key)

The popup window *Reset* sets the selected instrument settings to their default values. It is opened via the *RESET* key (*CONTROL keypad*).

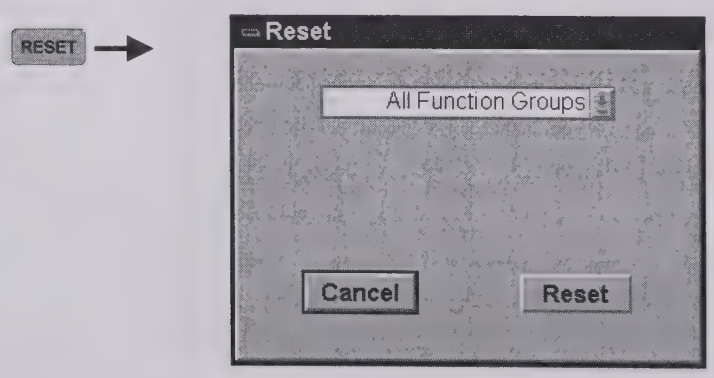


Fig. 4-2 Popup window Reset

Selection of the settings

The list field in the popup window Reset selects the settings or function groups to be reset. The following settings are available:

- All Function Groups — Reset all settings

Reset The *Reset* button resets the selected settings.

A verify window pops up where the reset can be confirmed. While the reset is performed, the message *Reset in progress* is displayed. Then the popup window is closed.

Remote control `SYSTem:PRESet`

Cancel The *Cancel* button cancels the selection that has been made and closes the menu.

Cancel is selected by default when the *Reset* menu is opened.

Print Menu (PRINT Menu)

The popup window *Print* permits to print the current screen as configured in the *Print* tab of the *Setup* menu. It is called up on pressing the *PRINT* key (*SYSTEM* keypad).

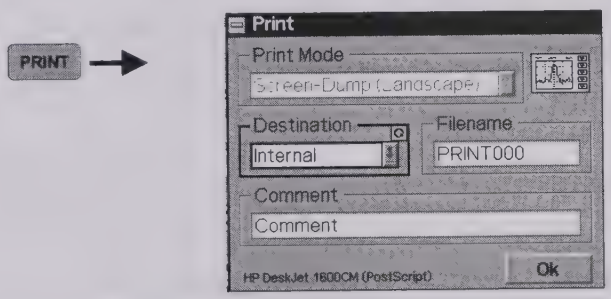


Fig. 4-3 Popup window Print

Print Mode The *Print Mode* select field permits to specify the data type for the output:

Screen-Dump (Landscape) Copy of the current display in landscape format

An example of a screen-dump copy is shown in a preview to the right of the select field.

Destination The *Destination* select field permits to specify the output destination for the data:

Printer Output to external printer connected via the parallel or one of the serial interfaces. The printer is configured in the *Setup –print* tab; see p. 4.6 ff.

Internal Storing in the current printer format to directory c:\temp\<Dir> where <Dir> is the target directory specified in the *Filename Default* input field of the *Setup – Print* tab. If <Dir> is not explicitly defined, the files are written to c:\temp.

Internal WMF Storing in *.wmf format.

External Storing in the current printer format to the <Dir> target directory (see *Internal* above) on the PCMCIA card (right-hand slot, assigned to drive d:\) or floppy disk (with option CMU-U61). A message box *Please insert disc ! Repeat ? Yes/No* pops up if no storage medium is inserted in the drive. To print, insert the appropriate medium and confirm with *Yes*.

External WMF Storing in *.wmf format to the PCMCIA card or floppy disk; see above.

Note: *To make processing of the generated data files easier, we recommend to use the External output destination.*

Filename If the data is to be written to a file, a file name can be specified in the *Filename* input field. By default, files are stored with the file name defined in the *Setup –print* tab (see p. 4.6). Groups of 1 to 3 adjacent question marks in this default name are replaced by current numbers starting with zero (auto-increment function). If a file name used before is specified, or if a file where all question marks have been replaced by "9" is already stored in the target directory, a message box *Print: overwrite existing file Yes/No* pops up. Pressing *No* aborts the print procedure and closes the *Print* popup menu.

Comment The input field *Comment* contains a comment (comprising up to 160 characters) for the current output. This field is not available if a *.wmf output is generated. When the output is sent to a printer the comment is written across the upper edge of the page.

Printer format The current printer format is indicated below the *Comment* input field. To change this format, open the *Setup –print* tab (see p. 4.6) to select another printer.

Ok The *Ok* button starts the data output and closes the *Print* menu.

To cancel the print process while preserving the current settings and close the *Print* menu press the *PRINT* key again.

Remote control –

Select Menu (Menu Select)

The select menu *(Menu Select)* permits to select the *Function Group* (i.e. the individual networks or other measurements), the test *Mode* (i.e. signalling or non-signalling) and the measurement menu group within the selected function group *(Menu)*. It appears after termination of the startup procedure of the CMU or after pressing the *Menu Select* key. The select menu is closed after selection on pressing the *ENTER* key or the *MENU SELECT* key again. The *ESCAPE* key discards the current selection.

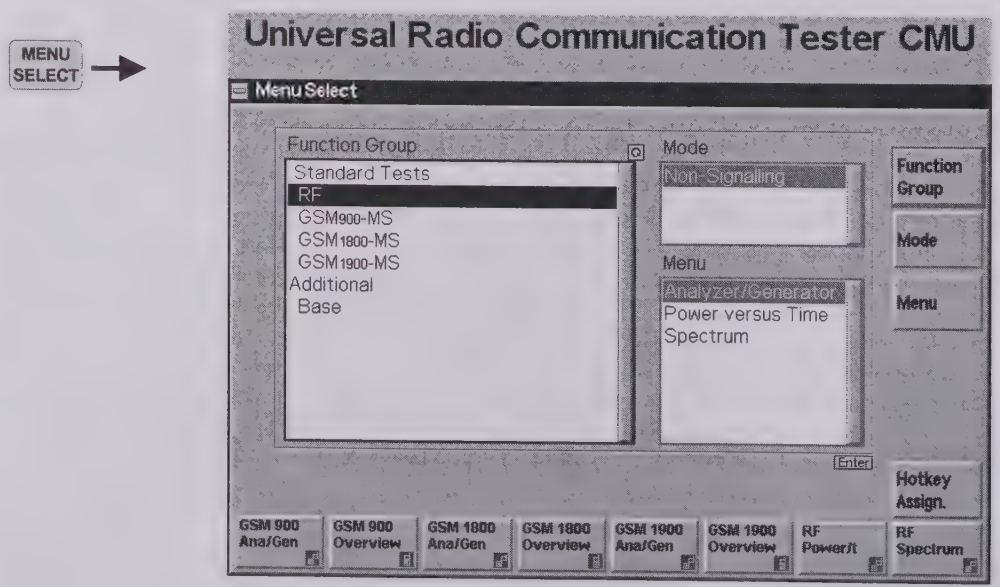


Fig. 4-4 Menu select

Function Group

The *Function Group* softkey selects the function group to be accessed.

The CMU performs general RF measurements accessible via the function group:

RF RF Measurements, see below in this chapter

If equipped with option CMU-B41, it provides AF measurements via the function group:

Audio Audio Generator and Analyzer, see below in this chapter

It is a versatile measuring instrument for a large variety of digital and analog network tests (all of them are optional, see separate manuals). For a complete list of deliverable network tests please refer to the data sheet.

Mode

The *Mode* softkey selects the test mode (signalling mode).

The function groups providing network tests are divided into two parts:

Non Signalling Module tests; measurements without transmission of signalling parameters and call setup.

Signalling Measurements with signalling and call setup to the device under test.

Menu

The *Menu* softkey selects the measurement group.

Each function group and test mode provides various measurement groups consisting of measurement menus and specific configuration menus. A complete graphical overview of all menus of the CMU basic system and the function groups *RF* and *Audio* can be found at the end of chapter 3 in this manual.

Hotkey Assign.

The *Hotkey Assign.* softkey activates the assign mode used to assign a hotkey to the function group, signalling mode and measurement menu currently selected.

The eight hotkeys of the *Menu Select* menu have a default assignment. Each hotkey gives direct access to the menu assigned to it.

In the assign mode, the *Hotkey Assign.* softkey turns into *Exit Assign* softkey and a message is displayed:

Press a hotkey to assign the current menu selection or press the delete key followed by the hotkey to be de-assigned.
Exit Assign.
GSM 900 Overview
GSM 900 Ana/Gen
GSM 1800 Overview
GSM 1800 Ana/Gen
GSM 1900 Overview
GSM 1900 Ana/Gen
RF Power/t
RF Spectrum

- To assign a hotkey (or to change the current assignment), select the desired function group, mode and menu, and press *Hotkey Assign.* followed by the hotkey. Press *Exit Assign.* to quit the assign mode.
- To cancel a hotkey assignment, press *Hotkey Assign.* followed by the delete key and the hotkey. Press *Exit Assign.* to quit the assign mode.

Remote control

The CMU uses extended addressing: The instrument itself is identified by the primary GPIB address. Moreover, a secondary address must be assigned to any combination of a function group and a signalling mode. This is done via the command

`SYSTem:REMote:ADDRess:SECondary <Address>,<FGrp>|NONE`

Primary and secondary address handling is described in the remote control chapters (in particular, refer to chapter 5 and the program examples in chapter 7).

Popup Menu Setup

The popup menu *Setup* contains several tabs used to adapt the CMU to user requirements. The menus are opened by pressing the *Setup* key. It is possible to change between the tabs by pressing the associated hotkeys.

Printer Settings (Setup – Print)

The *Setup – Print* menu controls the output of data from the CMU to a printer or a storage medium. The following configurations are provided:

- Printer type and port selection *(Printer)*
- Page settings for the selected printer *(Page Settings)*
- A header for the printed page *(Header)*
- Default file name and directory *(Filename Default)*

Some of the *Setup – Print* configurations serve as default settings and can be modified in the *Print* popup menu before the print process is started (see p. 4.3).

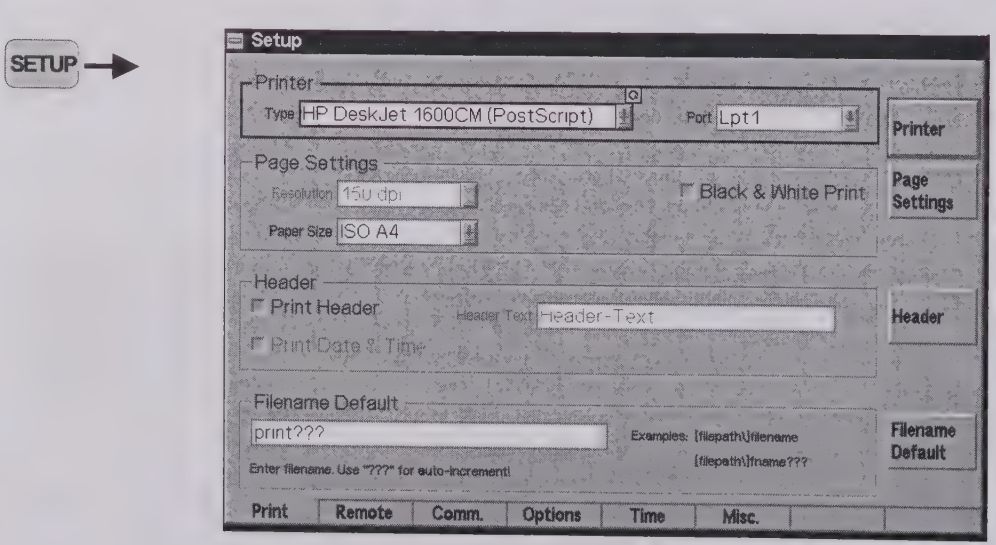


Fig. 4-5 Printer configuration menu (Setup – Print)

Printer

The *Printer* softkey selects a printer type and the printer port. The connection of a printer is described in chapter 1.

Page Settings

The *Page Settings* softkey activates the input of the page settings for the selected printer.

Paper Size Selection of ISO A4 or US LETTER paper

Black & White print Color (check box off) or black & white printer

The printer resolution is 150 dpi.

Header

The *Header* defines and activates header for the printed page.

Print header Print the header defined in the *Header Text* input field when a page is printed. An additional comment for every single page can be defined in the *Print* popup menu (see p. 4.3).

Print Date & Time Inclusion of the current date and time in the header, provided that a header is to be printed.

Header Text Input field for a header with a maximum length of two lines.

Filename Default

The *Filename Default* softkey defines a default file name and directory for an output that is written to an internal or external storage medium.

It is possible to specify a path separated from the filename by a backslash "\" in order to create a directory structure on the storage medium. This path is relative to directory c:\temp of the CMU hard disk *(Internal* storage) or the root directory of the *External* storage medium.

Auto-increment function

Groups of 1 to 3 adjacent question marks within the file name are replaced by current numbers that are automatically incremented, starting with zero. The file name *PRINT???* means that the first file stored will be *PRINT000*, the next one will be *PRINT001* etc. For n consecutive question marks, 10^n chronologically ordered and numbered files can be generated. In the last file name of the series, all question marks will be replaced by "9".

Remote control –

Remote-control Settings (Setup – Remote)

The remote-control menu *(Setup Remote)* defines the remote-control parameters of the CMU:

- Selection of the interface *(SCPI-Connection)*,Setting of the IEC-bus address of the CMU *(Primary Address)*,
- Selection of the desired function group *(Second. Address)*.

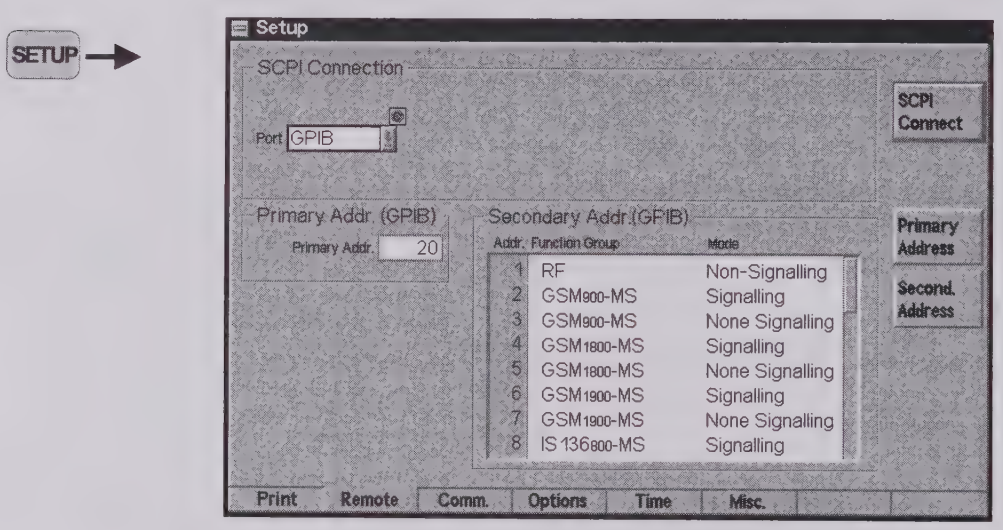


Fig. 4-6 IEC-bus menu

SCPI Connect

The *SCPI Connect* softkey determines the remote-control interface of the CMU.

- The following interfaces are available:
- *GPIB* IEEE-bus interface according to IEEE 488,
- *COM 1* serial (RS-232-C) interface COM 1,
- *COM 2* serial (RS-232-C) interface COM 2.

For the characteristics of the interfaces see chapter 1 and chapter 8, "Hardware Interfaces ".

Primary Address

The *Primary Address* softkey sets the IEC-bus address of the CMU. The default setting is 20; addresses 0 to 30 are permissible.

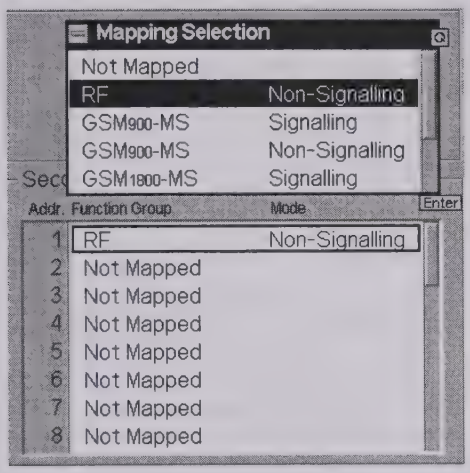
The IEEE-bus address is addressed in the remote-control commands in the form of the associated *primary address*, see chapter 5, *Putting the CMU into Operation for Remote Control*, and chapter 7, *Program Examples*.

Remote control

```
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess  0 to 30
SYSTem:REMote:ADDRess:PRIMary  0 to 30
```

Second. Address

The *Second. Address* softkey activates a field for selecting the desired function group and the signalling state.



The network and the test (signalling) mode are addressed in the remote-control commands in the form of the associated *secondary address*, see chapter 5, *Putting the CMU into Operation for Remote Control,* and chapter 7, *Program Examples*.

Remote control `SYSTem:REMote:ADDRess:SECondary 1 to 30,<FgrpName> | NONE`

Setting the Serial Interfaces (Setup – Comm.)

The interface menu *(Setup Comm.)* defines the transmission parameters of the serial outputs COM 1 and COM 2.

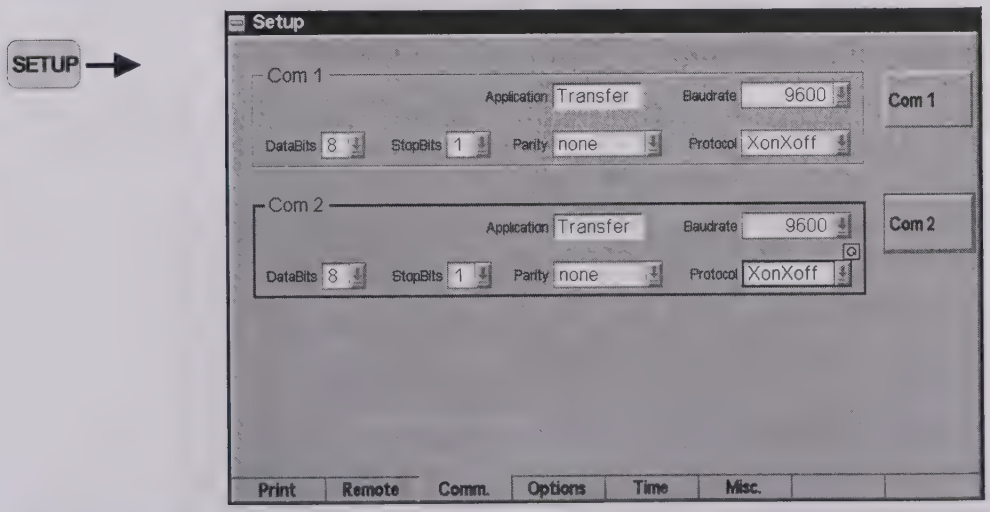


Fig. 4-7 Interface menu

COM 1

The *COM 1* softkey defines the transmission parameters for the serial interface COM 1.

If required, the transmission parameters must be set such as to comply with the parameters of the addressed device (PC etc.). The interface characteristics are explained in detail in chapter 8, *Hardware Interfaces*. The individual parameters are presented in Table 4-1 below.

The *Application* field indicates whether the serial port is used as a printer connector *(Printer,* if COM 1 was selected as printer port in the *Print* tab; see p. 4.6) or for data transfer to the controller (Transfer, default setting). This parameter can not be changed in the *Comm.* tab.

Remote control
```
SYSTem:COMMunicate:SERial1:APPLication
SYSTem:COMMunicate:SERial1:TRANsmit:PACE... etc.
```

Table 4-1: Transmission parameters of the serial interfaces

Parameter	Meaning	Value range
Application	Addressed device	Transfer | Printer (fixed setting)
Baud rate	Data transmission rate	110 |300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200
Data Bits	Number of data bits	7 | 8
Stop Bits	Number of stop bits	1 | 2
Parity	Number of parity bits	none | odd | even
Protocol	Transmission protocol	none | XonXoff | CtsRts

COM 2

The *COM 2* softkey defines the transmission parameters for the serial interface COM 2. The parameters are analogous to the COM 1 parameters.

Remote control
```
SYSTem:COMMunicate:SERial2:APPLication
SYSTem:COMMunicate:SERial2:TRANsmit:PACE... etc.
```

Installation of Options (Setup – Options)

The option menu *(Setup Options)* provides information on the type of instrument *(Info)* and the installed options *(Options)*. New software options purchased can be enabled in this menu using a code number.

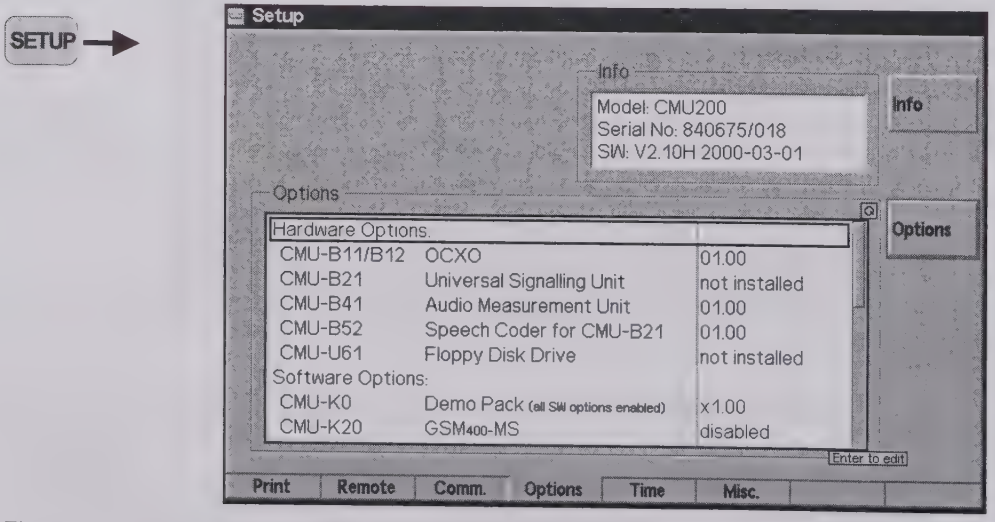


Fig. 4-8 Option menu

Info

The *Info* softkey opens a field where information on the instrument is listed.

The information field contains the following specifications:

Model	instrument model,
Serial No.	serial number of the instrument,
Base SW	installed firmware with date of release.

Remote control `SYSTem:OPTions:INFO?`

Options

The *Options* softkey activates a list of all hardware and software options and accessories for the CMU.

Software options purchased with the instrument are already enabled; additional software options can be enabled by simply entering a key code (see below). Further information on the options can be found in the data sheet. Installation and removal of hardware options is described in chapter 4 of the CMU service manual.

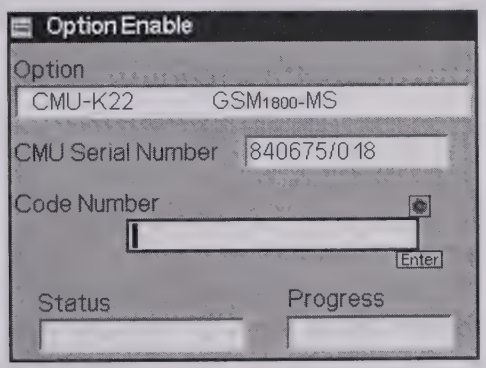
Remote control `SYSTem:OPTions?`

Enabling options

Additional software options purchased can be enabled in the list field of the *Options* softkey. As all software options are already included in the firmware, enabling does not require any re-installation, but only a key code which is supplied with the option.

- Select the respective line in the options list (in the example of Fig. 4-8 the line "CMU-K22 GSM1800-MS disabled"),
- Press the *Enter* key.

The input window *Option Enable* appears on the screen:



The *Option Enable* window contains the following fields:

- *Option* Short designation and name of option,
- *CMU Serial Number* Serial number of the CMU basic instrument,
- *Code Number* Code number of the option to be installed,
- *Status* Indication of the next operating step to perform,
- *Progress* Progress of the enabling procedure.

Of the fife fields, only the *Code Number* can be edited. The name of the option being enabled and the serial number of the CMU are automatically entered into the corresponding fields.

- Enter the code number of the option in the input field *Code Number.*
- Confirm the entry using *Enter.*

The option is automatically enabled.

Remote control –

Time Settings (Setup – Time)

The *Setup Time* tab shows and permits to change the following settings:

- The (current) time zone, time and time convention *(Time)*
- The (current) date *(Date)*

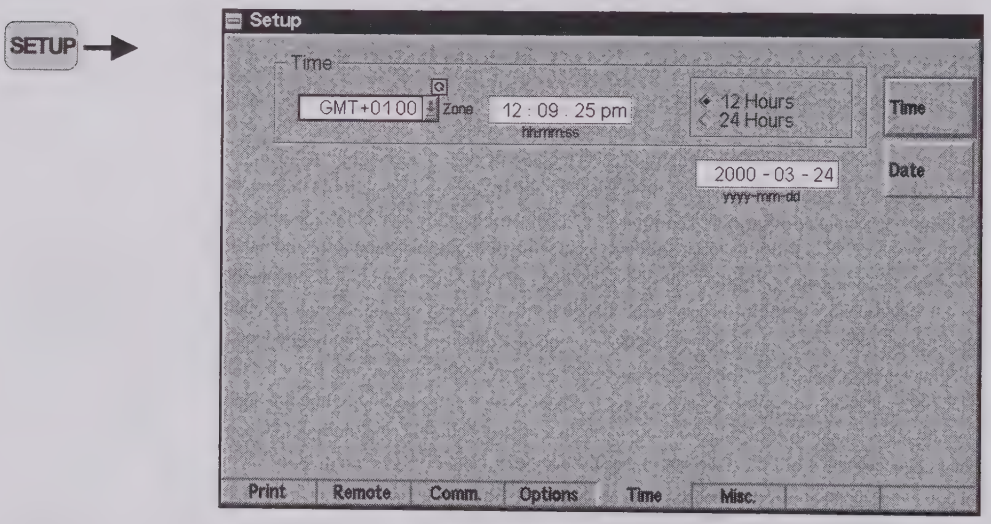


Fig. 4-9 Time menu

Time

The *Time* softkey defines the current time and its display format.

- It activates the following input fields:
- *Zone* Selection of the time zone, Middle European time (Greenwich mean time (GMT) + 1 h) is set by default,
- *hh:mm:ss.* Time in the format hours:minutes:seconds,
- *12 hours* English time convention: 12:00:00 am ... 11:59:59 am, 12:00:00 pm ... 11:59:59 pm,
- *24 hours* European time convention: 0:00:00 ... 23:59:59.

Remote control
```
SYSTem:TIME:TIME
SYSTem:TIME:TZONe
```

Date

The *Date* softkey defines the current date in the format yyyy-mm-dd (year-month-day).

Remote control
```
SYSTem:DATe
```

Acoustic Signal and Keyboard (Setup – Misc.)

The *Setup Misc.* menu activates the acoustic signal *(key beep)* and selects the keyboard assignment *(Keyboard)*.

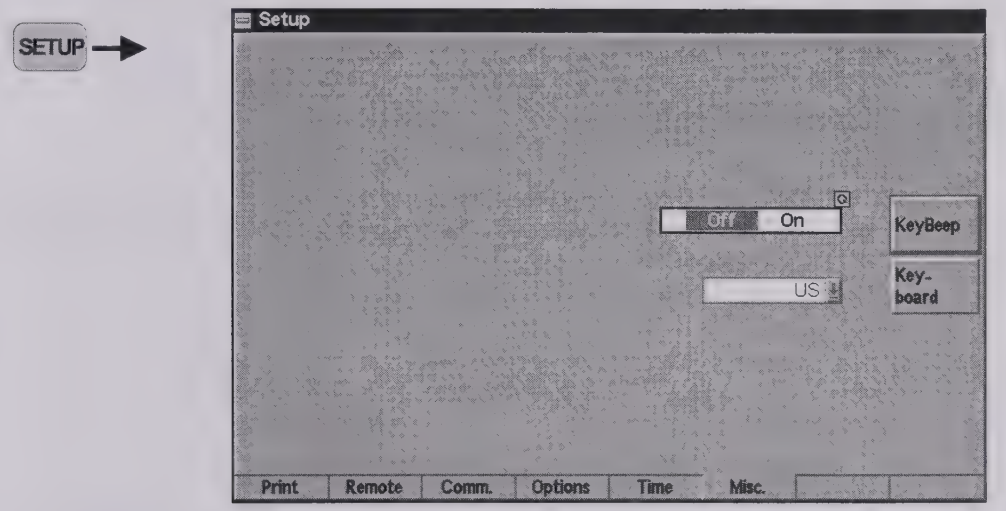


Fig. 4-10 Setup – Misc. menu

Key Beep

The *Key Beep* softkey switches the acoustic signal of the CMU on or off.

If the key beep is on the CMU sends a discreet acoustic signal whenever a key is pressed. The default setting is *Off*.

Remote control `SYSTem:MISCellaneous:KBEep`

Key-board

The *Keyboard* softkey selects the keyboard assignment (German or US keyboard).

Remote control `SYSTem:MISCellaneous:KEYBoard`

System Information (Info)

In the *Info* popup menu opened by the *INFO* key, comprehensive information on the instrument and its components can be displayed, and a number of selftest functions is provided. This information is intended for service purposes.

Selftest (Info, Maintenance)

The *Maintenance* popup menu accessible via the *BASE* function group in the *Menu Select* menu complements the *Info* menu (see above) in providing service information and selftests. The information is intended for service and diagnostics purposes.

RF Measurements (RF Non Signalling)

This section describes the measurement and configuration menus of function group *RF Non Signalling*. It is organized as follows:

1. Configuration of the RF output signal and RF analyzer settings *(Analyzer/Generator)*
2. Measurement menus *(Power vs Time* and *Spectrum):* Measurement menus, results, configuration menus.
3. General (global) configurations *(Group Configuration, Connection Control)*

Measurement Menu Analyzer/Generator

The main menu *Analyzer/Generator* configures the RF generator and analyzer and displays the power of the received signal.

The main menu *Analyzer/Generator* is opened from the main menu *Menu Select* (with associated key at front of instrument). It can also be accessed from the other measurement menus of the function group *RF Non Signalling* via the Ana./Gen hotkey.

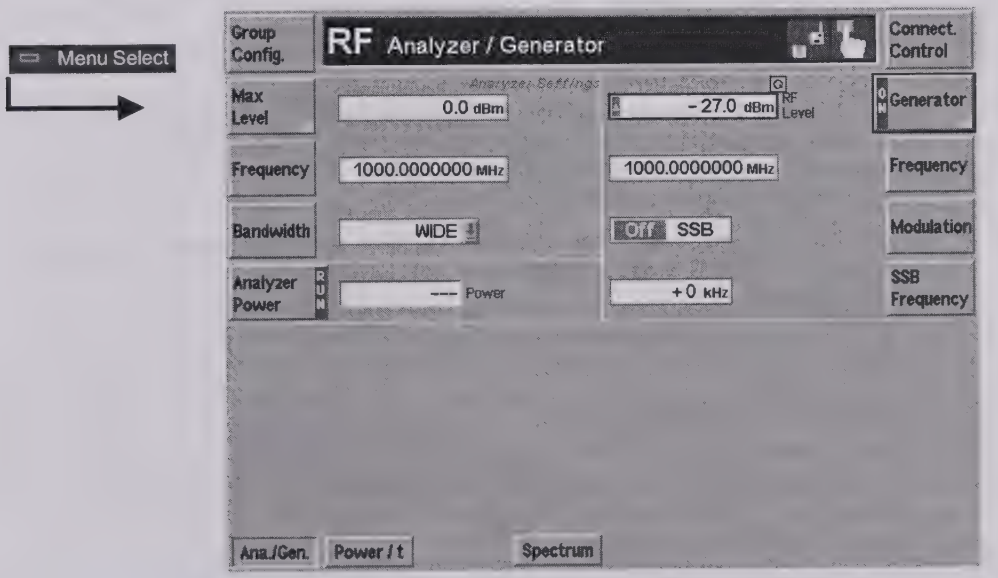
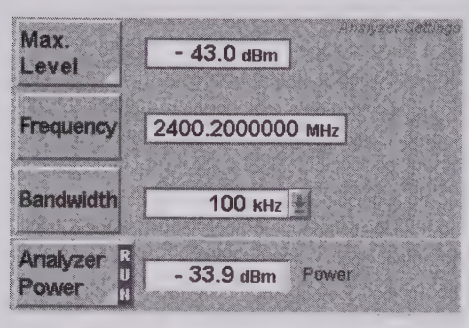


Fig. 4-11 Measurement menu Analyzer / Generator

Analyzer Settings

The *Analyzer* panels configure the RF analyzer, control the measurement of the signal power and indicate the result. The signal power can be analyzed in detail in time-domain (oscillographical) and frequency-domain (spectral) representation in the measurement menus *Power vs Time* (p. 4.21) and *Spectrum* (p. 4.28).



The panel *Analyzer* contains three input fields for the maximum level, the input frequency and the resolution bandwidth of the analyzer. Below, the analyzer can be started and stopped and the power of the measured signal is indicated.

Max. Level

The *Max. Level* softkey sets the maximum expected input level, i.e. it limits the input level which can be measured by the CMU.

This parameter is identical with the maximum input level in the popup menu *Group Configuration* (see page 4.40). The range of values depends on the RF input used. If an external input attenuation is reported to the instrument (see section *Control of Input and Output Signals (Connection Control – Signal)* on page 4.35), all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.

Input levels exceeding the *Max. Level* can not be measured; the corresponding measurement result fields indicate "– – –".

The input field is activated when the softkey is pressed once (softkey selection, *Max. Level* can be edited). Pressing the selected softkey once again calls up the popup menu *Group Configuration* (see page 4.40) with the tab *Input Level*. The *Group Configuration* menu can be closed on pressing *Max. Level* for a third time.

In the *Group Configuration* menu, either manual or automatic setting of the input level can be selected. The behavior of the *Max Level* softkey depends on the way the input level is set:

- In manual mode, the input level is indicated in the input field to the right of the softkey. This field can be activated and the level changed by pressing the softkey once. If the softkey is pressed again, the Group Configuration menu is called up (see page 4.40).
- If autoranging is selected, *Auto* is indicated in the input field to the right of the softkey. This field can not be activated. Instead, if the softkey is pressed once, the Group Configuration menu is called up (see page 4.40) to change the input level and mode.

This setting has no impact if the bandwidth is set to *WIDE*.

Remote control `[SENSe:]LEVel:MAXimum <LEVel>`

Frequency

The *Frequency* softkey defines the center frequency of the analyzer.

This setting is identical with the frequency setting in the graphical measurement menus *Power vs. Time* (p. 4.22).

Remote control `[SENSe:]POWer:FREQuency:CENTer <Frequency>`

Bandwidth

The *Bandwidth* softkey defines the resolution bandwidth of the analyzer.

The nominal resolution bandwidth is the 3-dB bandwidth of the selection filter. From a list discrete bandwidths between 10 Hz and 1 MHz can be selected. The frequencies in the list are given by $1x10^n$ Hz, $2x10^n$ Hz, $3x10^n$ Hz, $5x10^n$ Hz where n=1 to 5. In addition the two values 1 MHz and WIDE (denoting measurement at the front end with no restriction of the analyzer frequency) can be selected.

The wide-band measurement is only accurate if the correct center frequency is set.

Resolution bandwidths for the *Power vs. Time* and *Spectrum* measurements can be set independently (pp. 4.22, 4.28).

Remote control

```
[SENSe:]RFANalyzer:BANDwidth[:RESolution] <Bandwidth>
```

Analyzer Power

The *Analyzer Power* softkey indicates the status of the measurement *(RUN | HLT | OFF)*.

This status can be changed by means of the *ON/OFF* and *CONT/HALT* keys after softkey selection (pressing once). The current result (mode *RUN*) or the latest result (modes - - - (for *Off*), *HLT*) is indicated in the output field next to the softkey.

Remote control

```
INITiate:RFANalyzer
ABORt:RFANalyzer
STOP:RFANalyzer
CONTinue:RFANalyzer
FETCh:RFANalyzer:STATus?
FETCh[:SCALar]:RFANalyzer:POWer[:RESult]? etc.
```

Generator Settings

The layout and function of the panel for configuration of the generator signals is identical with the *Signal* tab in the *Connection Control* popup menu (see page 4.35).

Generator

The softkey *Generator* controls the RF generator and indicates its operating status *(ON | HLT | OFF)*.

The RF generator can be switched on or of after softkey selection (press once) using the *ON/OFF* key. Pressing the *Generator* softkey twice opens the popup menu *Generator Configuration* (see page 4.19) providing further configuration settings.

The level is entered in the associated input field *RF Level* as an absolute value (in dBm). The value range depends on the selected RF output (RF 1, RF 2 or RF 3 OUT).

External attenuation

If an external gain or attenuation is used and reported to the instrument (see softkey *Ext. Att. Output* in the menu *Connector/Ext. Att.* on page 4.36) the RF generator level is adjusted to maintain the commanded power after the attenuation or gain. As a consequence, all levels indicated are referenced to the input of the DUT and no longer correspond to the actual level at the output connectors of the CMU (see section *Control of Input and Output Signals (Connection Control – Signal)* on page 4.35). The default value for the generator power is also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.

Error messages

If the value determined for *RF Level* is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit."* and three fields will appear:

Accept	The permissible max. value is accepted as RF Level,
Re-edit	RF Level is entered once again,
Cancel	The last valid input value is maintained.

When switching over to another output, the current value of *RF Level* is automatically adapted, if required:

- towards lower values to the maximum permissible value of the new output,
- towards upper values to the minimum value of the new output.

Remote control

```
INITiate:RFGenerator
ABORt:RFGenerator
FETCh:RFGenerator:STATus?
FETCh[:SCALar]:RFGenerator:POWer[:RESult]? etc.
SOURce:RFGenerator:LEVel <Level>
```

Frequency

The *Frequency* softkey defines the frequency of the generated RF signal.

Remote control

```
SOURCe:RFGenerator:FREQuency <Frequency>
```

Modulation

The *Modulation* softkey selects the modulation mode of the RF signal.

The frequency of the RF signal may be unmodulated *(Off)* or shifted by a constant offset frequency *(SSB)* defined with the *SSB Frequency* softkey.

Remote control

```
SOURce:RFGenerator:MODulation OFF | SSB
```

SSB Frequency

The *SSB Frequency* softkey defines an offset for shifting the frequency of the RF signal (single side band frequency). An application is given in chapter 7.

Remote control

```
SOURce:RFGenerator:MODulation:SSB:FREQuency <Deviation>
```

Generator Configuration

The popup menu *Generator Configuration* contains two tabs which configure the RF signal generator. It is opened by pressing the *Generator* softkey in the Analyzer/Generator menu twice. It is possible to change between the tabs by pressing the associated hotkeys.

Power and Frequency Control (Generator Configuration – Hopping)

The tab *Hopping* defines the following characteristics of the RF generator signals:

- switchover between two frequencies *(Frequency Hopping)*,
- time dependence of the signal power *(Ramping)*.

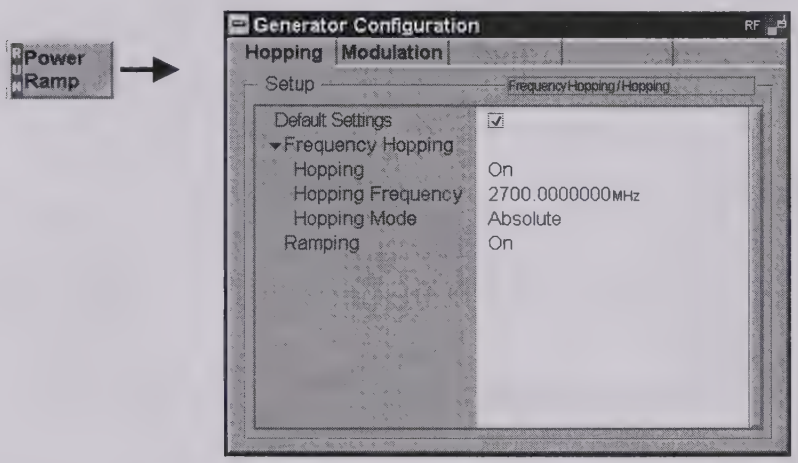


Fig. 4-12 Generator Configuration – Hopping

Frequency Hopping

The *Frequency Hopping* field defines whether the RF generator generates a signal with a single, constant basic frequency (frequency hopping *Off*) or a signal with two alternating frequencies (frequency hopping *On)* .

The basic frequency is defined via the *Frequency* softkey in the *RF Analyzer/Generator* menu. The second (hopping) frequency can be entered in the *Hopping Frequency* input field. Two definitions of the hopping frequency are provided:

Absolute The absolute value of the hopping frequency is entered.

Relative The difference between the hopping frequency and the basic frequency is entered. The resulting absolute frequency, i.e. $f_{abs} = f_{rel} + f_{base}$ must lie in the permissible range for the CMU (see data sheet).

If frequency hopping is selected the RF signal frequency changes after every 4.615 ms: the dwell time at a frequency is as for GSM signals.

Remote control

```
SOURce:RFGenerator:FHOPping:STATe <ON | OFF>
SOURce:RFGenerator:FHOPping:FREQuency <Frequency>
SOURce:RFGenerator:FHOPping:FREQuency:MODE
                                    <ABSolute | RELative>
```

Ramping The *Ramping* field defines whether the RF generator generates a continuous, unmodulated signal (CW signal, Ramping is *Off)* or a series of pulses (Ramping is *On)*.

If ramping is selected the CMU generates rectangular, GSM-like pulses with a duration of 577 ms.

Remote control `SOURce:RFGenerator:PULSe:STATe <ON | OFF>`

Modulation Filter (Generator Configuration – Modulation)

The tab *Modulation* selects the bandwidth of the modulation filter.

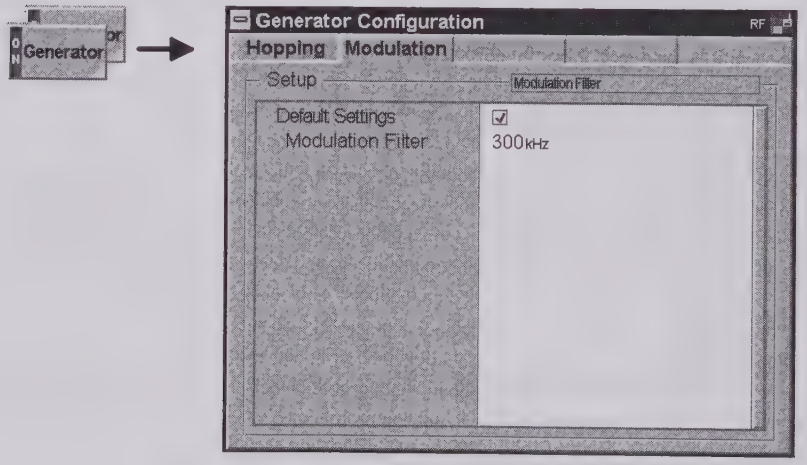


Fig. 4-13 Generator Configuration – Modulation

Modulation Filter The *Modulation Filter* field defines the resolution bandwidth of the modulation filter. The bandwidths 30 kHz, 300 kHz or off (corresponding to a broadband modulation filter) can be selected.

In a *Spectrum* measurement a modulation filter suppresses the signals located to the right and to the left of the center frequency.

Remote control `SOURce:RFGenerator:BANDwidth[:RESolution] <Bandwidth>`

Measurement Menu Power vs Time

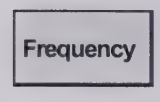
The menu group *Power vs Time* comprises the functions for measurement of the signal power as a function of time (oscillographic representation in a restricted frequency range, e.g. for burst analysis). The popup menu *Power vs Time Configuration* is used for configuration of the measurements; the measurement results are displayed in the graphical measurement menu *Power vs Time*.

Measurement Menu (Power vs Time)

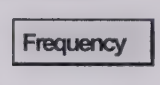
The graphical measurement menu *Power vs Time* displays the results of the power measurement in the time domain.

- The main softkey *Power vs Time* indicates the status of the power measurement *(RUN | HLT | OFF)* and opens the configuration menu *Power vs Time Configuration*.
- The other softkeys to the right of the test diagram are combined with alternating hotkeys (the *hotkeys Freq.* and *RBW* are associated with the softkey *Frequency* in the example below*)*. If a softkey is selected and an associated hotkey pressed, a popup window will appear which indicates the current setting and enables an entry.

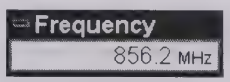
Example:



The *Frequency* softkey displays a hotkey bar including the hotkey *Frequency*.



The *Frequency* hotkey opens the input window *Frequency*.



Input windows indicate the current parameter value (in this case: the frequency of the ongoing measurement) and a list of the possible settings. Parameters are changed by

- overwriting/incrementing numerical values (for numeric parameters),
- selecting from the list of parameters (for select parameters).

The measurement menu *Power vs Time* is opened from the main menu *Menu Select* (with the associated key at the front of the instrument) or using the *Power/t* hotkey.

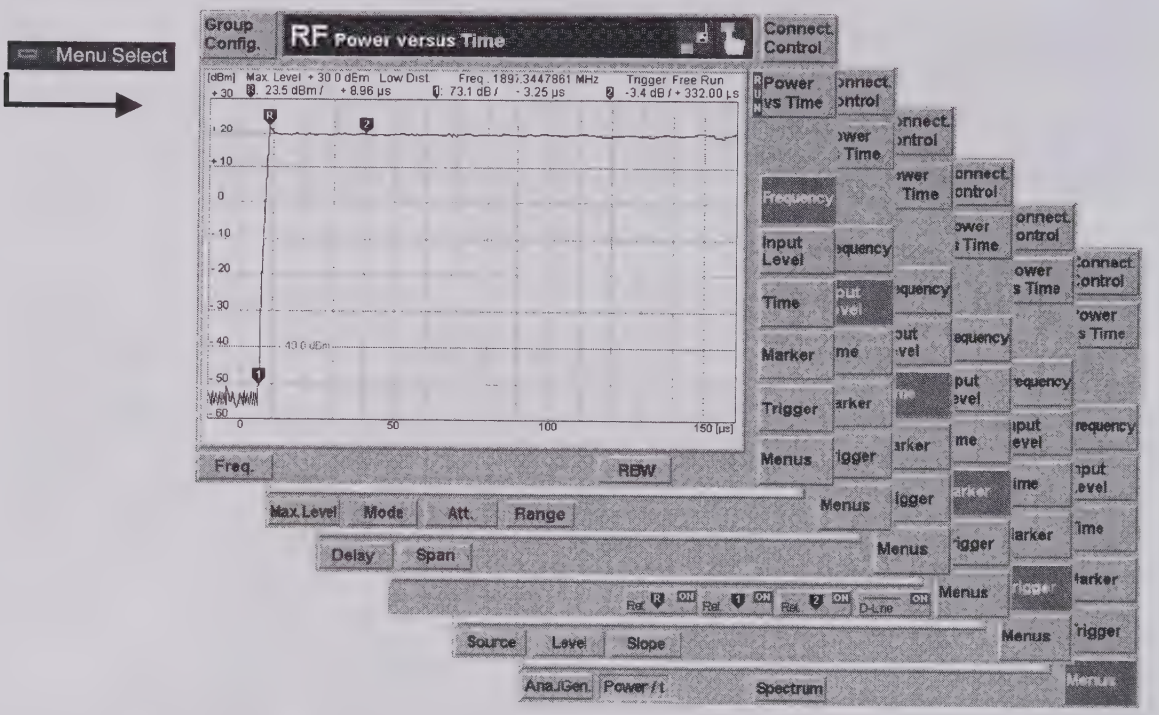


Fig. 4-14 Measurement menu Power vs Time

Test settings

Frequency

The *Frequency* softkey activates hotkeys for entering the center frequency of the measured signal and the resolution bandwidth.

Freq.

The *Freq.* hotkey defines the center input frequency for the measurement in MHz.

This setting is identical with the frequency setting in the *Analyzer Settings* panel of the *Analyzer/Generator* menu (p. 4.15).

Remote control `[SENSe:]POWer:FREQuency:CENTer <Frequency>`

RBW

The *RBW* hotkey opens the input window for the resolution bandwidth.

The nominal resolution bandwidth is the 3-dB bandwidth of the selection filter. From a list discrete bandwidths between 10 Hz and 1 MHz can be selected. The frequencies in the list are given by $1x10^n$ Hz, $2x10^n$ Hz, $3x10^n$ Hz, $5x10^n$ Hz where n=1 to 5. In addition the value 1 MHz can be selected.

Resolution bandwidths for the analyzer and the *Spectrum* measurement can be set independently (p. 4.15, 4.28).

Remote control
```
[SENSe:]POWer:FREQuency:BANDwidth[:RESolution] <Bandwidth>
[SENSe:]POWer:FREQuency:BWIDth[:RESolution] <Bandwidth>
```

Input Level

The *Input Level* softkey defines the input level settings.

Max Level

The *Max Level* hotkey defines the maximum expected input level.

See section *Input Level (Group Configuration – Input Level)* on page 4.40.

Remote control `[SENSe:]LEVel:MAXimum <LEVel>`

Mode

The *Mode* hotkey determines how the input level is defined.

Manual Manual input of reference level,

Auto Automatic setting according to the power of the applied signal.

See section *Input Level (Group Configuration – Input Level)* on page 4.40.

Remote control `[SENSe:]LEVel:MODE MANual | AUTOmatic`

Att.

The *Att.* hotkey selects a strategy for tuning the RF analyzer.

Normal Mixer level in normal range.

Low Noise Enhanced mixer level. This setting ensures the full dynamic range of the CMU and is therefore recommended for *Power* vs time and *Spectrum* measurements.

Low Distortion Decreased mixer level.

See section *Input Level (Group Configuration* – Input Level) on page 4.40.

Remote control `[SENSe:]LEVel:ATTenuation NORMal | LNOIse | LDIStortion`

Range

The *Range* hotkey defines the level range of the *Power vs Time* measurement.

From the popup window one of the ranges 10 dB, 20 dB, 30 dB, 50 dB, 80 dB or 100 dB can be selected. Note that, in contrast to the reference level, the range selection doesn't have any impact on the measurement

The ordinate scale is calculated from the maximum level defined in the Group Config. menu (page 4.40) and the range such that

- The *Max Level* defines the upper edge of the diagram.
- The difference *Max Level – range* defines the lower edge of the diagram.
- The number of horizontal grid lines (corresponding to 10, 15, or 16 cells) and the ordinate labeling is adapted to the range.

Remote control `[SENSe:]POWer:LEVel:RANGe <Range>`

Time

The *Time* softkey configures the measurement time and the abscissa (time axis).

Delay

The *Delay* hotkey defines a delay time for the *Power vs Time* measurement.

The start of the measurement is delayed relative to the trigger time. At the same time the delay time defines the left edge of the abscissa in the measurement diagram.

The permissible range of delay times depends on the timebase (see below) and on the resolution bandwidth of the power measurement. As a general rule, larger values are allowed if the timebase is increased and the resolution bandwidth decreased.

Remote control `[SENSe:]POWer:TIME:DELay <Delay>`

Span

The *Span* hotkey determines the measurement time.

The abscissa scale is calculated from the delay and the span assuming a constant number of 10 horizontal cells:

- The *delay* defines the left edge of the diagram.
- The *delay* + *span* defines the right edge of the diagram.
- The abscissa labeling is adapted to the delay and timebase.

Remote control `[SENSe:]POWer:TIME:SPAN <Span>`

Marker

The *Marker* softkey positions up to 3 markers and a D-line in the test diagram and reads their values.

Markers are graphical tools for marking points on the measurement curve and for numerical output of measured values. The measurement menu *Power vs Time* provides a reference marker and two further markers which permit to measure differences (delta markers 1 and 2).
The coordinates of the three markers are indicated in the format *Ordinate value (level)/abscissa value (time)* in the second parameter line above the test diagram. The position of the reference marker is expressed in absolute units (level in dBm and time in symbols), the delta marker in absolute or relative units (relative level in dB or time differences from the reference marker).

D-line The D-line (display line) is a horizontal line that can be positioned to mark and read out an arbitrary level in the test diagram.

Ref R

The hotkey *Ref. R* switches the reference marker on or off (use the *ON/OFF* key).

The reference marker is represented by the symbol R in the test diagram. The marker position (abscissa) is determined in the input field *Ref. Marker R*. The marker can be positioned to arbitrary time values. If its position is outside the diagram area it will be invisible and its coordinates will be "- - - / <abscissa_value>". The marker is switched off in the default setting *(OFF)*. The marker level is given by the trace at the marker position.

The position of all markers can be varied using the rotary knob.

Remote control No command, screen configuration only.

Rel. 1

The *Rel. 1* hotkey switches the delta marker 1 on or off (use the *ON/OFF* key).

The delta marker 1 is represented by the symbol 1 in the test diagram. The marker position (abscissa) is determined in the input field *Rel. Marker 1*. The marker can be positioned to arbitrary time values. If its position is outside the diagram area it will be invisible and its coordinates will be "- - - / <abscissa_value>". The marker is switched off in the default setting *(OFF)*. The marker level is given by the trace at the marker position.

The toggle switch *Marker Config. 1* is opened by pressing *Rel. 1* twice and defines whether the second parameter line shows the absolute position of the delta marker (*absolute*, in dBm and time units) or its distance to the reference marker (*relative*, in dB and time units). If *absolute* is selected the inscription of the *Rel. 1* hotkey changes to *Abs. 1*.

Remote control No command, screen configuration only

Rel. 2

The *Rel. 2* hotkey switches the delta marker 2 on or off (use the *ON/OFF* key).

Functions are analogous to delta marker 1.

D-Line

The *D-Line* hotkey switches the D-line in the test diagram on or off (*ON/OFF* key).

The D-line is a horizontal, colored auxiliary line in the test diagram and is used for marking a level value and for measuring level differences. The level (ordinate) is determined in the input field *D-Line* and indicated on the D-line. The permissible value range is the diagram area, the default setting is Off.

The switch *D-Line Config.* is opened by pressing *D-Line* twice and determines whether the D-line level is expressed in absolute units (in dBm, setting absolute) or relative to the Max. Level (in dB, setting relative).

Remote control: No command, screen configuration only

Trigger

The *Trigger* softkey sets the trigger source, slope and level.

The trigger settings are discussed in section *Trigger (Group Configuration – Trigger)* on page 4.41.

Menus

The *Menus* softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The values represented in the measurement menu *Power vs Time* can be divided into three groups:

- Setting values
- Scalar measurement results (marker values)
- The trace plotted as a function of time

These values are indicated in two parameter lines and the test diagram:

Parameter line 1/2

Test diagram with reference marker, delta marker 1 and 2 and D-line.

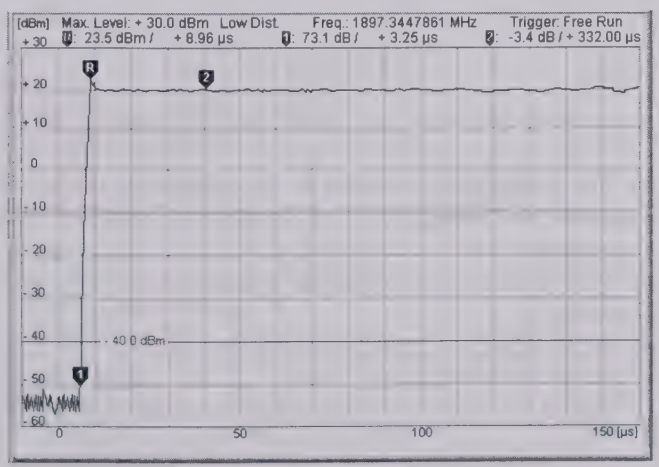


Fig. 4-15 Display of measurement results (Power vs Time menu)

Settings/ scalar measurement results

Settings and scalar measurement results are indicated in the two parameter lines above the test diagram

1st parameter line

The first parameter line contains the following settings:

Max. Level	Maximum value of input level set as in *Group Config. – Input Level* (see p. 4.40).
Attenuation	Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)* set as in *Group Config. – Input Level* (see p. 4.40).
Freq.	Center frequency of the RF signal analyzed
Trigger	Trigger mode *(Free Run, RF Power, IF Power* or *External)*

2nd parameter line

The second parameter line contains the following marker values:

- R Level and time of reference marker
- 1 Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)
- 2 Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)

Remote control

Settings are read out using the query corresponding to the setting command (setting command with appended question mark).

To obtain the measurement value at a single point on the trace the whole trace must be read, see below.

Measurement curves (fields)

The measurement curve is displayed as a continuous trace in the test diagram together with the limit lines, markers and the D-line, if defined.

The measurement curve in the *Power vs Time* measurement menu shows the measured burst power (in dBm) as a function of time (in µs). The displayed result depends on the test settings made before.

Remote control

```
READ:ARRay:POWer[:RESult][:CURRent]?
FETCh:ARRay:POWer[:RESult][:CURRent]?
SAMPle:ARRay:POWer[:RESult][:CURRent]?
```

Measurement Configurations (Power vs Time Configuration)

The popup menu *Power vs Time Configuration* determines the parameters of the power measurement. It is activated by pressing the softkey *Power vs Time* in the graphical measurement menu *Power vs Time* twice.

The *Power vs Time Configuration* menu controls the power measurement. It defines:

- The repetition mode *(Repetition)*.
- Besides, it influences the power display by adding a *Grid* or not.

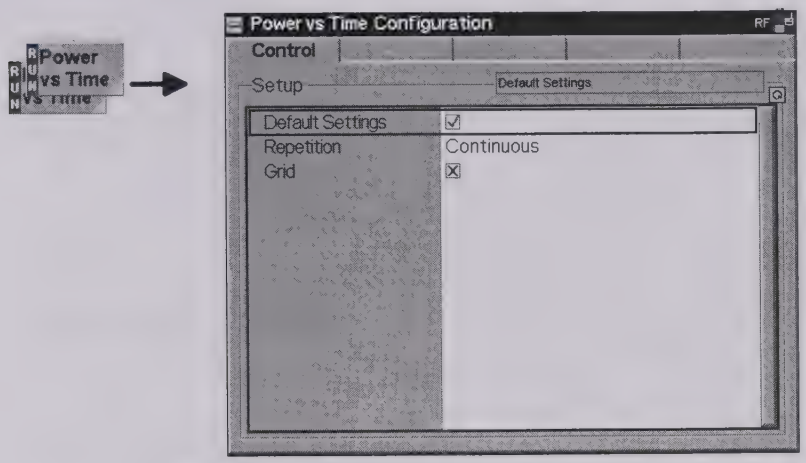


Fig. 4-16 Power vs Time Configuration – Control

Repetition The *Repetition* field determines the repetition mode:

Single Shot Single-shot measurement: the measurement is stopped after one cycle, i.e. after evaluation of the trace over the entire time range. A stopped measurement is indicated by the status display *HLT* in the *Power vs Time* softkey.

Continuous Continuous measurement: The CMU measures permanently until the measurement is explicitly stopped via the *Power vs. Time* softkey in the graphical measurement menu. The measurement results are valid after one statistic cycle; however, the measurement is continued, and the output is continuously updated. An ongoing measurement is indicated by the status display *RUN* in the *Power vs Time* softkey.

Single shot should always be selected if only a single measurement result is required under fixed conditions. The continuous measurement is suitable for monitoring the evolution of a measured quantity in time, for example for adjustments.

Note: *In remote mode, the counting measurement (counting mode) is available as a further repetition mode with a defined number of measurement cycles to be performed, see chapter 6 of this manual.*

Remote control
```
CONFigure:POWer:CONTrol:REPetition
     CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Grid The *Grid* button switches on or off the grid in the graphical test diagram.

Remote control
```
CONFigure:POWer:CONTrol:GRID  ON | OFF
```

Measurement Menu Spectrum

The menu group *Spectrum* measures the signal power as a function of the frequency (spectrum analysis). The popup menu *Spectrum Configuration* is used for configuration of the measurements; the results (i.e. the spectrum) are displayed in the graphical measurement menu *Spectrum*.

Measurement Menu (Spectrum)

The graphical measurement menu *Spectrum* displays the results of the spectrum analysis (measurement of signal power as a function of the frequency).

- The main softkey *Spectrum* indicates the status of the spectrum analysis *(RUN | HLT | OFF)* and opens the configuration menu *Spectrum Configuration.*
- The other softkeys to the right of the test diagram are combined with alternating hotkeys. If a softkey is selected and an associated hotkey pressed, a popup window will appear which indicates the current setting and enables an entry (see section *Measurement Menu (Power vs Time)* on page 4.21).

The measurement menu *Spectrum* is opened from the main menu *Menu Select* (with the associated key at the front of the instrument) or using the *Spectrum* hotkey.

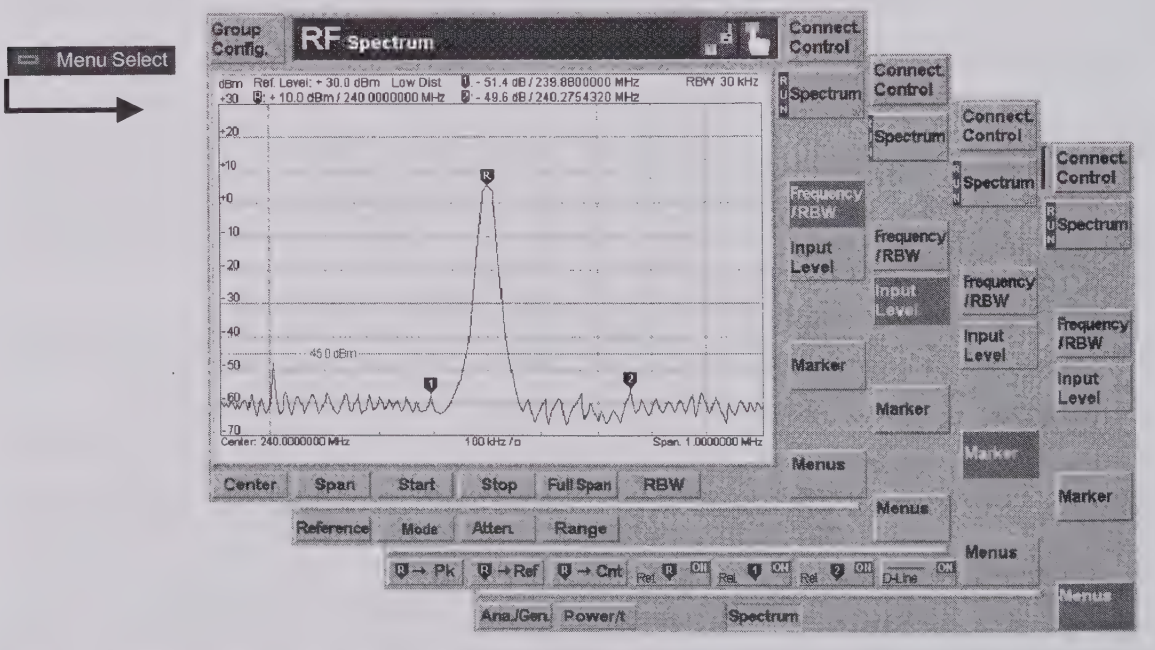


Fig. 4-17 Measurement menu Spectrum

Test settings

Frequency /RBW

The *Frequency* softkey activates the input of the frequency range measured and displayed and of the resolution bandwidth.

A single measurement of the signal power over the whole frequency range (span, sweep width) by means of a spectrum analyzer is called a sweep. Typically, the minimum sweep time T_{min} is linked to the resolution bandwidth B of the analyzer and the frequency range F by the relation $T_{min} \sim F/B^2$.

This means that a compromise between a high resolution, wide frequency range and high measurement speed must be reached.

The frequency range can be set in three different ways:

1. By defining the center frequency f_c and the span Δf. The start and stop frequencies are thus given by $f_{start} = f_c - \Delta f/2$ and $f_{stop} = f_c + \Delta f/2$. This mode is convenient if the spectrum is to be analyzed in the vicinity of a known frequency which can be used as the center frequency of the diagram.
2. By defining the start frequency f_{start} and the stop frequency f_{stop}. The center frequency and span are thus given by $f_c = (f_{start} + f_{stop})/2$ and $\Delta f = f_{stop} - f_{start}$.
3. By selecting *Full Span* the default frequency range is displayed, i.e. the default start and stop frequencies are selected.

The number of vertical grid lines (i.e. the number of cells in horizontal direction) can be variable (depending on the frequency span) or fixed, see *Spectrum Configuration* menu on page 4.34.

Center

The *Center* hotkey defines the center input frequency of the analyzer in MHz or in another frequency unit selected via the unit keys.

Remote control `[SENSe:]SPECtrum:FREQuency:CENTer <Frequency>`

Span

The *Span* hotkey defines the sweep span.

Remote control `[SENSe:]SPECtrum:FREQuency:SPAN <Frequency>`

Start

The *Start* hotkey defines the start frequency of the sweep.

Remote control `[SENSe:]SPECtrum:FREQuency:STARt <Frequency>`

Stop

The *Stop* hotkey defines the stop frequency of the sweep.

Remote control `[SENSe:]SPECtrum:FREQuency:STOP <Frequency>`

FullSpan

The *FullSpan* hotkey sets the default sweep span.

On pressing the *FullSpan* hotkey the abscissa of the spectrum diagram is changed, and the resolution bandwidth is set to *Auto*. However, the previous scaling parameters and resolution bandwidth are stored and the inscription of the *FullSpan* hotkey changes to LastSpan. The *LastSpan* hotkey allows the previous scaling parameters and resolution bandwidth to be recalled and the previous diagram to be restored.

Remote control Set Start and Stop to their default values. Resolution bandwidth see below.

RBW

The *RBW* hotkey defines the resolution bandwidth for the *Spectrum* measurement.

The nominal resolution bandwidth is the 3-dB bandwidth of the selection filter. From a list discrete bandwidths between 10 Hz and 1 MHz can be selected. The frequencies in the list are given by $1x10^n$ Hz, $2x10^n$ Hz, $3x10^n$ Hz, $5x10^n$ Hz where n=1 to 5. In addition the two values 1 MHz and *Auto* can be selected.

With the *Auto* setting the resolution bandwidth is automatically adapted to

bandwidth = span/50

(if this value is inside the allowed range).

Resolution bandwidths for the analyzer and the *Power vs Time* measurement can be set independently (p. 4.15, 4.22).

Remote control
```
[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution] <Bandwidth>
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution] <Bandwidth>
```

Input Level

The *Input Level* softkey sets the input level.

Reference

The *Reference* hotkey defines the reference level.

The reference level defines the upper edge of the diagram. It is generally different from the maximum input level set in the *Group Config.* menu, see section *Input Level (Group Configuration – Input Level)* on page 4.40.

Remote control
```
[SENSe:]LEVel:REFerence  <LEVel>
```

Mode

The *Mode* hotkey determines how the input level is defined.

Manual Manual input of reference level,

Auto Automatic setting according to the power of the applied signal.

See section *Input Level (Group Configuration – Input Level)* on page 4.40.

Remote control
```
[SENSe:]LEVel:MODE  MANual | AUTOmatic
```

Atten.

The *Atten.* hotkey selects a strategy for tuning the RF analyzer.

Normal Mixer level in normal range.

Low Noise Enhanced mixer level. This setting ensures the full dynamic range of the CMU and is therefore recommended for *Power* vs time and *Spectrum* measurements.

Low Distortion Decreased mixer level.

See section *Input Level (Group Configuration* – Input Level) on page 4.40.

Remote control
```
[SENSe:]LEVel:ATTenuation  NORMal | LNOIse | LDIStortion
```

Range

The *Range* hotkey defines the level range of the *Spectrum* measurement.

From the popup window one of the ranges 10 dB, 20 dB, 30 dB, 50 dB, 80 dB or 100 dB can be selected. In contrast to the resolution bandwidth the range has no impact on the measurement.

The ordinate scale is calculated from the maximum level defined in the *Group Config.* menu (page 4.40) and the range such that

- The maximum level defines the upper edge of the diagram.

- The difference *maximum level – range* defines the lower edge of the diagram.
- The number of horizontal grid lines (corresponding to 10, 15, or 16 cells) and the ordinate labeling is adapted to the range.

Remote control `[SENSe:]SPECtrum:LEVel:RANGe <Range>`

Marker

The *Marker* softkey positions up to 3 markers and a D-line in the test diagram and reads their values.

Markers are graphical tools for marking points on the measurement curve and for numerical output of measured values. The measurement menu *Spectrum* provides a reference marker and two further markers which permit to measure differences (delta markers 1 and 2).
The coordinates of the three markers are indicated in the format *Ordinate value (level)/abscissa value (frequency)* in the parameter lines above the test diagram. The reference marker position is indicated in absolute units (absolute level in dBm and time in µs), the delta marker position in absolute or relative units (relative level in dB or frequency deviation from the reference marker).

D-line The D-line is a horizontal line that can be positioned in the test diagram at will and is used for marking and reading level values.

R → Pk

The hotkey *R to Pk* places the reference marker to the maximum of the trace.

Cnt→ R

The hotkey *Cnt to R* centers the diagram to the frequency of the reference marker.

Ref→ R

The hotkey *Ref to R* sets the reference level to the current marker position.

It is recommended to use the three softkeys *R to Pk, Cnt to R* and Ref to R in succession to obtain a standard scale for the diagram.

Ref. R

The hotkey *Ref. R* switches the reference marker on or off.

The reference marker is represented by the symbol R in the test diagram. The marker position (abscissa) is determined in the input field *Ref. Marker R*. The marker can be positioned to arbitrary frequency values. If its position is outside the diagram area it will be invisible and its coordinates will be "- - - / <abscissa_value>". The marker is switched off by default. The marker level is given by the trace at the marker position.

The position of all markers can be varied using the rotary knob.

Remote control No command, screen configuration only

Rel. 1

The *Rel. 1* hotkey switches the delta marker 1 on or off.

The delta marker 1 is represented by the symbol 1 in the test diagram. The marker position (abscissa) is determined in the input field *Rel. Marker 1*. The marker can be positioned to arbitrary frequency values. If its position is outside the diagram area it will be invisible and its coordinates will be "- - - / <abscissa_value>". The marker is switched off by default. The marker level is given by the trace at the marker position.

The toggle switch *Delta Config.1* is opened by pressing *Rel. 1* twice and defines whether the second parameter line shows the absolute position of the delta marker (*absolute*, in dBm and time units) or its distance to the reference marker (*relative*, in dB and time units). If *absolute* is selected the inscription of the *Rel. 1* hotkey changes to *Abs. 1*.

Remote control No command, screen configuration only

Rel. 2 The *Rel. 2* hotkey switches the delta marker 2 on or off.

Functions are analogous to delta marker 1.

D-Line The *D-Line* hotkey switches the D-line in the test diagram on or off.

The D-line is a horizontal, colored auxiliary line in the test diagram and is used for marking a level value and for measuring level differences. The level (ordinate) is determined in the input field *D-Line* and indicated on the D-line. The permissible value range is the diagram area, the default setting is *Off.*

The switch *D-Line Config.* is opened by pressing *D-Line* twice and determines whether the D-line level is expressed in absolute units (in dBm, setting absolute) or relative to the Max. Level (in dB, setting relative).

Remote control No command, only screen configuration

Menus The *Menus* softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The values represented in the measurement menu *Spectrum* can be divided into three groups:

- Setting values
- Scalar measurement results (marker values)
- The trace plotted as a function of time

These values are indicated in two parameter lines and the test diagram:

Parameter line 1/2

Test diagram with reference marker, delta marker 1 and 2 and D-line.

Abscissa labels

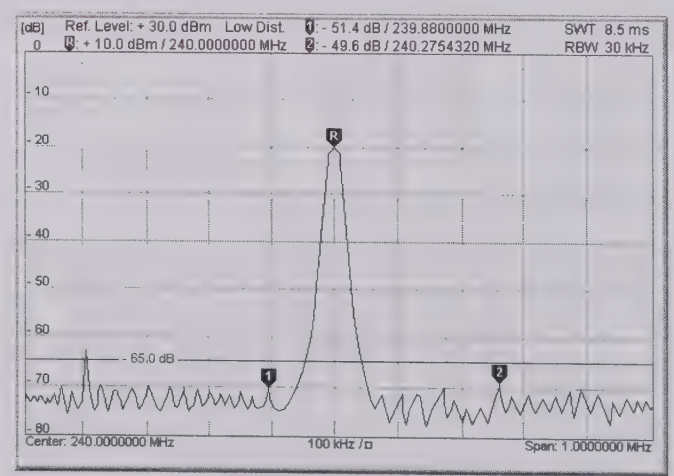


Fig. 4-18 Display of measurement results (Power vs Time menu)

Settings/ scalar measurement results

Settings and scalar measurement results are indicated in the two parameter lines above the test diagram

1st parameter line

The first parameter line contains the following settings:

Ref. Level	Maximum value of input level set in the *Group Configuration* menu (see page 4.40).
1	Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)
RBW	Resolution bandwidth (Auto or numeric value)

2nd parameter line

The second parameter line contains the following marker values:

R	Level and time of reference marker
2	Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)

Remote control

Settings are read out using the query corresponding to the setting command (setting command with appended question mark).

To obtain the measurement value at a single point on the trace the whole trace must be read, see below.

Measurement curves (fields)

The measurement curve is displayed as a continuous trace in the test diagram together with the limit lines, markers and the D-line, if defined.

The measurement curve in the *Spectrum* measurement menu shows the measured burst power (in dBm) in spectral representation, i.e. as a function of the frequency (in MHz). The displayed result depends on the test settings made before.

Remote control

```
READ:ARRay:POWer[:RESult][:CURRent]?
FETCh:ARRay:POWer[:RESult][:CURRent]?
SAMPle:ARRay:POWer[:RESult][:CURRent]?
```

Measurement Configurations (Spectrum Configuration)

The popup menu *Spectrum* determines the parameters of the spectrum analysis. It is activated by pressing the softkey *Spectrum* in the graphical measurement menu *Spectrum* twice.

The *Spectrum Configuration* menu controls the spectrum analysis. It defines:

- The repetition mode *(Repetition)*.

Besides, it influences the spectrum display by adding a *Grid* with configurable cells or not.

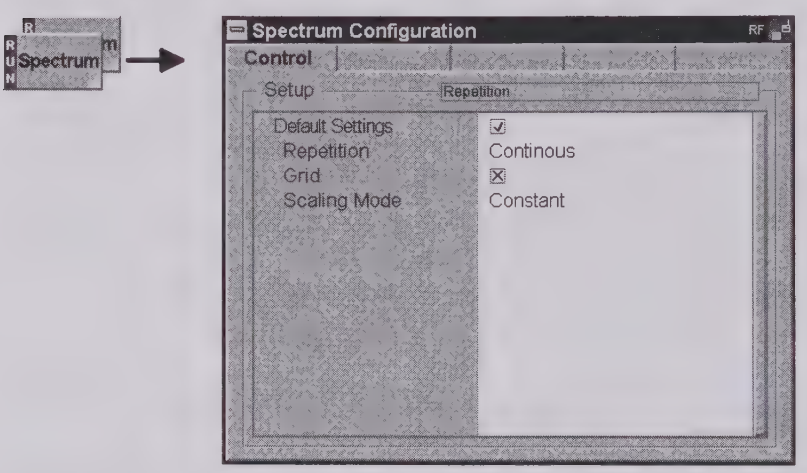


Fig. 4-19 Spectrum Configuration – Control

The functions of this menu comply with those of the menu *Control* in the menu group *Power vs Time* (see page 4.26). In the remote-control commands, the keyword `POWer` is to be replaced by `SPECtrum`.

Repetition The *Repetition* field determines the repetition mode, see chapter 3 and explanations given on page 4.27 for the *Power vs. Time* measurement.

Remote control
```
CONFigure:SPECtrum:CONTrol:REPetition
        CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Grid / Scaling Mode The *Grid* button switches on or off the grid in the graphical test diagram. In addition the *Scaling Mode*, i.e. the number of grid cells in horizontal direction (frequency axis) can be selected:

- *Variable* The number of horizontal grid cells is adapted to the sweep span of the *Spectrum* measurement, see page 4.29,
- *Constant* The diagram consists of a constant number of 10 horizontal grid cells.

Remote control
```
CONFigure:SPECtrum:CONTrol:GRID  ON | OFF
```

Menu Group Connection Control

The popup menu *Connection Control* consists of three tabs which configure the inputs and outputs of the CMU and the respective signals in the function group *RF Non Signalling.*

The menu group is activated via the softkey *Connect. Control* to the right of the header of each measurement menu. The individual tabs *(Signal, RF* and *Synch.)* can be selected via the hotkey bar at the lower edge of the screen.

Control of Input and Output Signals (Connection Control – Signal)

The tab *Signal* configures the RF generator. The CMU generates sine wave signals which can be configured as follows:

- Level and frequency of the generator signal *(RF Level, Frequency)*
- Offset frequency of the generator signal *(Modulation, SSB Frequency)*

All the setting values of this menu are also displayed in the main menu *Analyzer/Generator* (see page 4.15).

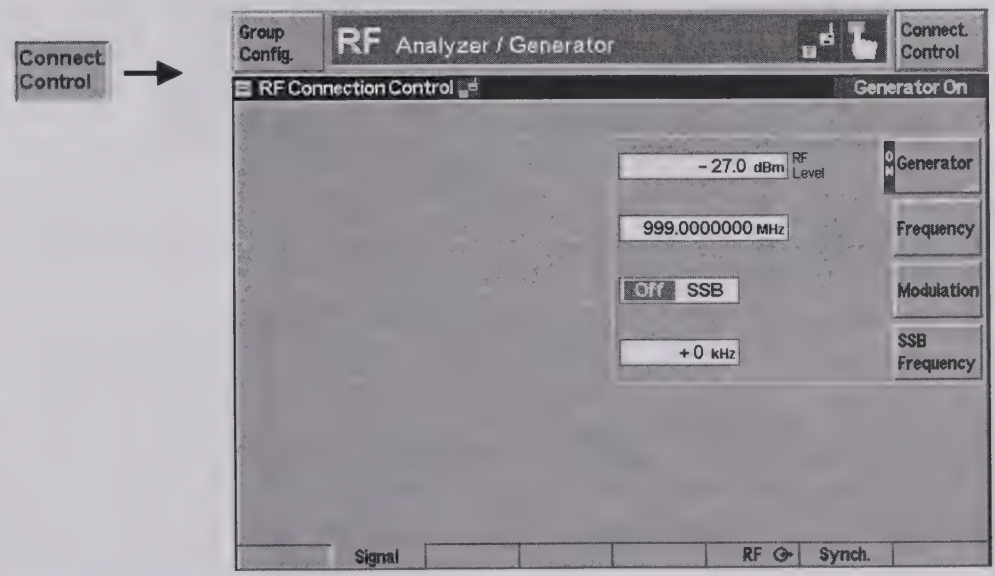


Fig. 4-20 Connection Control – Generator signals

RF Connectors (Connection Control – Connector/Ext. Att.)

The tab *RF* ⊶ configures the connectors for RF signals. This includes the setting of

- The RF input and output of the CMU *(RF Output, RF Input)*
- An external attenuation at the connectors (Ext. Att. Output, Ext. Att. Input)

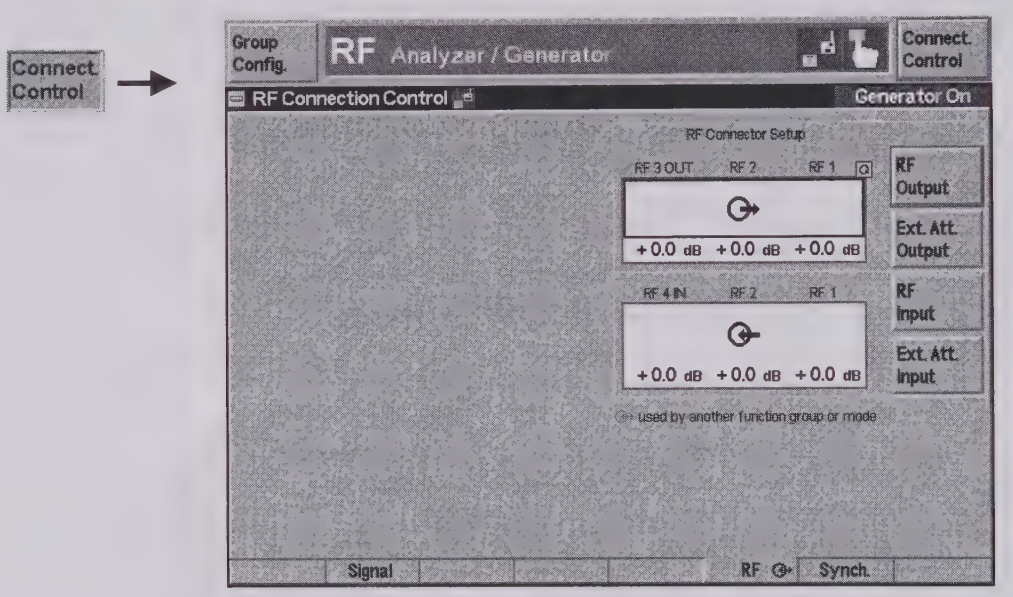


Fig. 4-21 Connection Control – RF connectors

RF Output

The *RF Output* softkey defines which of the three connectors RF 1, RF 2 and RF 3 OUT is to be used as RF output connector.

The selected RF output is indicated by a ⊶ symbol.

Note: *Input and output connectors can be combined at will. The bidirectional connectors RF 1 and RF 2 can be selected as RF inputs and outputs at the same time.*

The LEDs on the front panel are only „on" (light) if the output level is switched on.

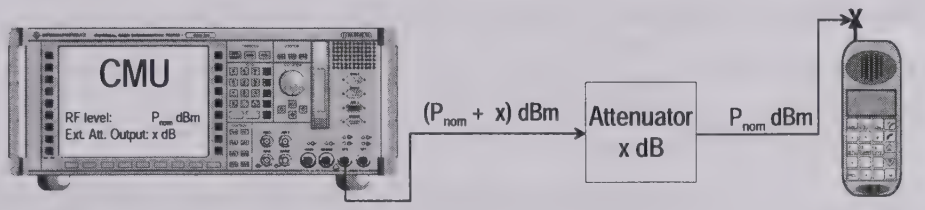
Remote control `OUTPut[:STATe] RF1 | RF2 | RF3`

Ext. Att. Output

The softkey *Ext. Att. Output* defines an external attenuation (or gain, if the value is negative) at the selected RF output.

Input of an external attenuation is suitable if, e.g., a path attenuation (cable) is included in the test setup, which is to be corrected by an increased signal level.

If an external attenuation is defined, the output signal level is referenced to the input of the DUT, the generator level is therefore shifted with respect to the actual level at the input connector of the CMU. The default value for the generator power and the level ranges for the RF outputs are also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.



Remote control
```
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] <Loss>
```

RF Input

The *RF Input* softkey determines which of the three connectors RF 1, RF 2 and RF 4 IN is to be used as RF input connector.

The selected RF output is indicated by a ⊖ symbol. Input and output connectors can be arbitrarily combined.

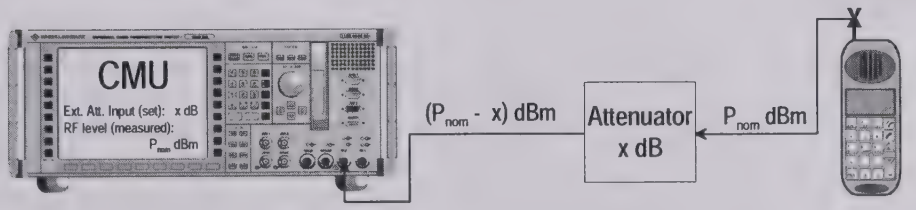
Remote control
```
INPut[:STATe] RF1 | RF2 | RF4
```

Ext. Att. Input

The softkey *Ext. Att. Input* enters the value of the external attenuation (or gain) at the selected RF input.

Input of an external attenuation is required if, for example, external attenuator pads are used for protection of the sensitive RF inputs of the CMU or if a path attenuation is included in the test setup.

If an external input attenuation is reported to the instrument, all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input connectors are shifted as well.



Note: *The LEDs on the front panel are only "on" (light) if the measurement is active.*

Remote control
```
[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude] <Loss>
```

Reference Frequency (Connection Control – Synch.)

The tab *Synch.* determines the reference signals for synchronization. This includes

- The internal or external *Reference Frequency*
- The output mode for the network-specific system clock *(REF OUT 2)*.

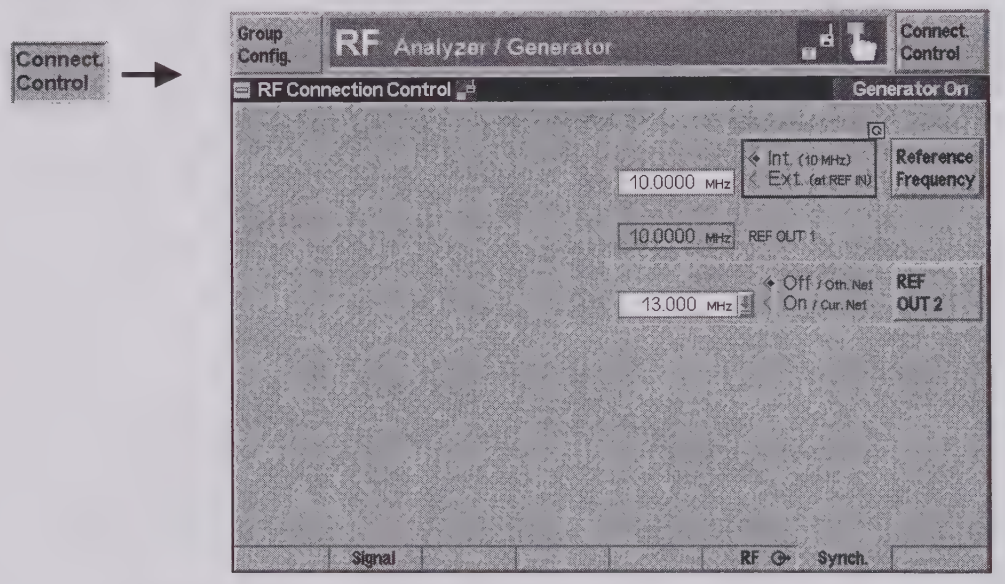


Fig. 4-22 Connection Control – Synchronization

Reference Frequency

The *Reference Frequency* softkey determines the source and the frequency of the reference signal.

The associated field permits to select between two alternatives:

Int. (10 MHz) internal synchronization with 10 MHz (TCXO or OCXO, CMU-B11/-B12) applied to output REF OUT 1 at the rear of the instrument.

Ext. (at REF IN) external reference signal to be fed in via input REF IN and applied to output REF OUT 1 at the rear of the instrument.

The frequency of the external reference signal must be entered in the input field next to the *External* button.

The reference signal used is applied to output *REF OUT 1* so that it can be fed to other instruments as well. It can be used for synchronization to another instrument.

Note:

1. *The header cyclically displays a warning if no synchronization has been performed e.g. because of missing or faulty input signal with external synchronization selected.*
2. *In the case of external synchronization with squarewave signals (TTL) ensure correct signal matching to avoid reflections. Otherwise, resulting overshoots may cause trigger problems at the CMU input. A possible remedy is to use a lowpass filter or an attenuator pad directly at the CMU input. Correct synchronization may be checked by comparing the signal REF OUT 1 with the input signal.*
3. *This configuration is valid in* ***all*** *CMU function groups.*

Remote control

```
CONFigure:SYNChronize:FREQuency:REFerence:MODE <ON | OFF>
CONFigure:SYNChronize:FREQuency:REFerence <Frequency>
```

REF OUT 2

The softkey *REF OUT 2* configures a network-specific system clock REF OUT 2 to be fed to the output *REF OUT 2* at the rear of the instrument.

The associated field permits to select between two alternatives:

OFF (other network) The clock frequency of the current function group is not fed to the output REF OUT 2.

With this setting the system clock of another active function group (e.g. the network GSM1800 while the current network is GSM900) is still applied to REF OUT 2 provided that the output REF OUT 2 is switched on in the other function group. However, if REF OUT 2 is explicitly switched over from On to Off the clock signal is definitely removed.

On (current network) The network-specific system clock of the current function group is fed to output REF OUT 2. The system clock of any other function group applied to REF OUT 2 before is replaced.

Besides the basic clock frequency of 39 MHz one of the following clock frequencies may be selected:

39.000 MHz,	19.500 MHz,	13.000 MHz,	9.750 MHz,	7.800 MHz,	6.500 MHz,	5.571 MHz,
4.875 MHz,	4.333 MHz,	3.900 MHz,	3.545 MHz,	3.250 MHz,	3.000 MHz,	2.786 MHz,
2.600 MHz,	2.438 MHz,	2.294 MHz,	2.166 MHz,	2.053 MHz,	1.950 MHz,	1.857 MHz,
1.773 MHz,	1.696 MHz,	1.625 MHz,	1.560 MHz,	1.500 MHz,	1.444 MHz,	1.393 MHz,
1.349 MHz,	1.300 MHz,	1.258 MHz,	1.219 MHz			

(The values are calculated according to the formula $F_{out} = 39.000\ MHz / n$ where $n = 1, ..., 32$.)

The clock frequency can be used to synchronize other instruments.

Remote control

```
SOURce:DM:CLOCk:STATe ON | OFF
SOURce:DM:CLOCk:FREQuency <Frequency>
```

Popup Menu Group Configuration

The popup menu *Group Configuration* contains two tabs which configure the measurements in the function group RF globally, i.e., it provides settings that are valid for all measurement menus within the function group. Most of these settings can be overwritten in the individual graphical measurement menus using softkeys and popup input fields.

The popup menu *Group Configuration* can be activated by pressing the softkey *Group Config.* at the top left in each measurement menu. It is possible to change between the tabs by pressing the associated hotkeys.

Input Level (Group Configuration – Input Level)

The tab *Input Level* provides settings for the measured input level (see also section *Menu Group Connection Control* on page 4.35 ff.):

- Maximum value *(Max. Level)*
- Attenuation *(Attenuation)*

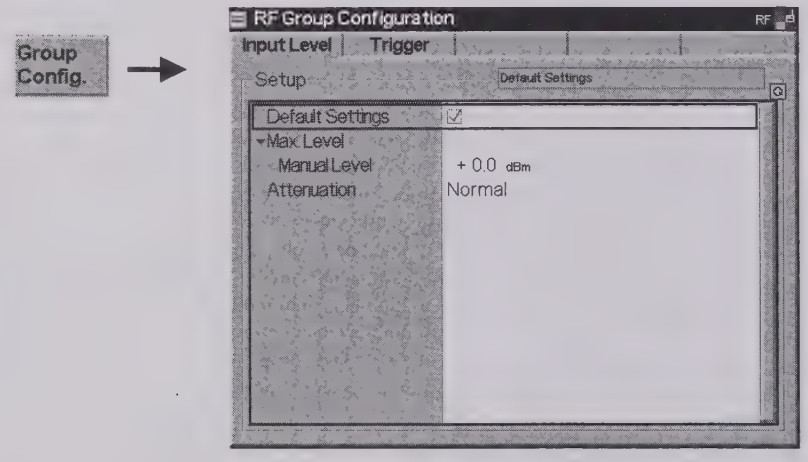


Fig. 4-23 Group Configuration – Input level

Max. Level The *Max. Level* field sets the input attenuator and thus determines the maximum permissible input level (overload level). The maximum input level determines the upper edge of the diagram in the graphical menu *Power vs. Time* and is also displayed next to the softkey *Max. Level* in the main menu *Analyzer/Generator* (see page 4.15). The upper edge of the *Spectrum* diagram is set independently via the *Reference* hotkey, see section *Test settings* on page 4.28.

Manual	Manual input of maximum input level
Auto	Automatic setting of maximum input level (autoranging) according to the power of the applied signal.

Remote control `[SENSe:]LEVel:MODE MANual | AUTOmatic`

The value range depends on the selected RF input (see section "Control of Input and Output Signals (Connection Control – Signal)" on page 4.35):

External attenuation If an external input attenuation is reported to the instrument (see section *RF Connectors (Connection Control – Connector/Ext. Att.)* on page 4.36), all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the CMU. The level ranges for the input

connectors are shifted as well.

Input levels exceeding the *Max. Level* can not be measured; the corresponding measurement result fields indicate "– – –".

Error messages

If the value determined for *Max. Level* is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit."* and three fields will appear:

- *Accept* The permissible max. value is accepted as Max. Level,
- *Re-edit* Max. Level is entered once again,
- *Cancel* The last valid input value is maintained.

When switching over to another input, the current value of *Max. Level* is automatically adapted, if required:

- towards lower values to the maximum permissible value of the new input,
- towards upper values to the minimum value of the new input.

Remote control

```
[SENSe:]LEVel:MAXimum <Level>
```

Attenuation

The *Attenuation* field defines how the RF analyzer of the CMU is tuned to meet the requirements of the current measurement type. In general, a compromise between the acceptable noise level in the displayed result and the contribution of internally generated distortion must be reached.

Normal Mixer level in normal range,

Low noise Mixer level enhanced by +10 dB (full dynamic range of CMU, therefore recommended for *Power* vs time and *Spectrum* measurements),

Low distortion Mixer level reduced by –10 dB (high intermodulation spacing, therefore recommended for modulation measurements).

The *Attenuation* setting permits the CMU to be adapted to the requirements of the measurement. The advantages and disadvantages of the settings *Low noise* and *Low distortion* are listed in the following table.

	Advantages	Disadvantages
Low noise	Low noise high dynamic range	No RF overdrive reserve Risk of intermodulation
Low distortion	High intermodulation spacing	Lower dynamic range

Remote control

```
[SENSe:]LEVel:ATTenuation  NORMal | LNOise | LDIStortion
```

Trigger (Group Configuration – Trigger)

The tab *Trigger* defines the trigger condition for the measurement.

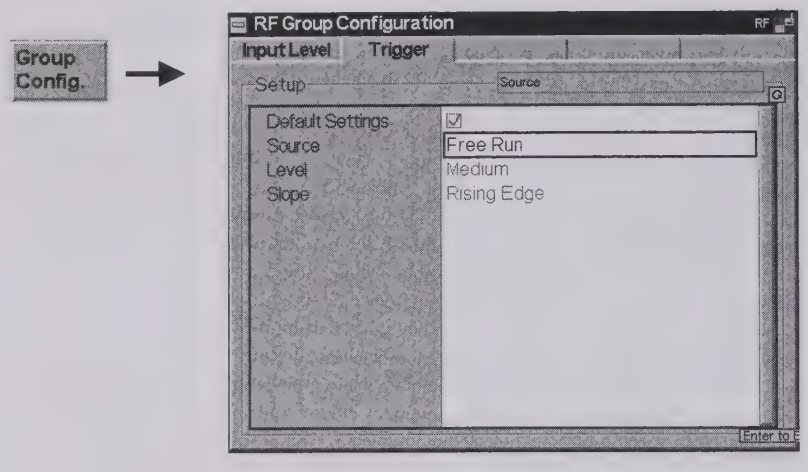


Fig. 4-24 Group Configuration – Trigger

Default The field *Default* assigns the default setting to all fields of the tab *Trigger*.

Remote control `CONFigure:TRIGger:DEFault ON | OFF`

Trigger The *Trigger* field determines how the measurement is to be triggered:

Free Run	free-run mode, the measurement is carried out continuously, it is not related to the input signal,
RF Power	the measurement is triggered by the level of the RF signal to be measured,
IF Power	the measurement is triggered by the level of the IF signal,
Extern	External trigger signal fed in via connector AUX3 (pin no. 8).

For the *RF Power* and *IF Power* parameters the trigger level is specified via the *Level* command. *RF Power* trigger signals have a small dynamic range which is often not sufficient for triggering. It is recommended to trigger by the *IF Power* instead.

Note: *If no measurement result can be obtained the trigger mode may not fit to the trigger signal applied. Check the trigger mode and signal.*

Remote control `TRIGger[:SEQuence]:SOURce IMMediate | RFPower | IFPower | EXTern`

Level The *Trigger Level* field determines the trigger threshold if the measurement is triggered by the *RF Power* or *IF Power*.

The trigger threshold is the level at which the trigger signal starts triggering. With free-run measurements the *Trigger Level* field is disabled.

Low	low trigger level equal to the reference level – 26 dB,
Medium	medium trigger level equal to the reference level – 16 dB,
High	high trigger level equal to the reference level – 6 dB,

Remote control `TRIGger[:SEQuence]:THReshold LOW | MEDium | HIGH`

Slope The *Slope* field determines whether the measurement is triggered by the rising or falling edge of the trigger signal. With free-run measurements or external trigger the *Slope* field is disabled.

Remote control `TRIGger[:SEQuence]:SLOPe POSitive | NEGative`

Options and Extensions

The function groups described in this section require the installation of hardware options; for a complete list of deliverable options refer to the data sheet. Software options for digital and analog network tests are described in separate operating manuals.

Audio Generator and Analyzer (Option CMU-B41)

Option CMU-B41, *Audio Generator and Analyzer*, provides an additional *Audio* function group comprising the functions for generating and measuring audio signals. It can be accessed either from the *Menu Select* menu (standalone audio measurements) or by switching over from any of the *GSM900/1800/1900-MS* measurement menus (either in *Non Signalling* or *Signalling* mode). In the latter case, the audio circuit of a GSM mobile station can be tested without releasing a call connection or changing the signalling state of the CMU.

Standalone *audio* measurements are performed with default connector settings, the audio signals being applied to the connectors *AF IN* (input) and *AF OUT* (output) on the front panel of the instrument (see chapter 1). If *Audio* is used in the context of *GSM900/1800/1900-MS* measurements, the *AF/RF* tab of the associated *Connect. Control* menu allows to select the input source of the CMU speech encoder and the output destination of its speech decoder (see *GSM900/1800/1900-MS* operating manual).

Measurement Menu Audio Analyzer/Generator

The main menu *Analyzer/Generator* defines the sinusoidal signal generated by the audio generator and displays the voltage of the measured audio signal.

The *Analyzer/Generator* menu is opened from the main menu *Menu Select* (with associated key at front of instrument) or via the *Audio* hotkey which is available in all *GSM900/1800/1900* measurement menus. In the latter case, the previous (calling) GSM function group and the symbol indicating the test mode is displayed in the menu header, and a hotkey switching back to the GSM function group shows at the bottom of the menu (see Fig. 4-25 below).

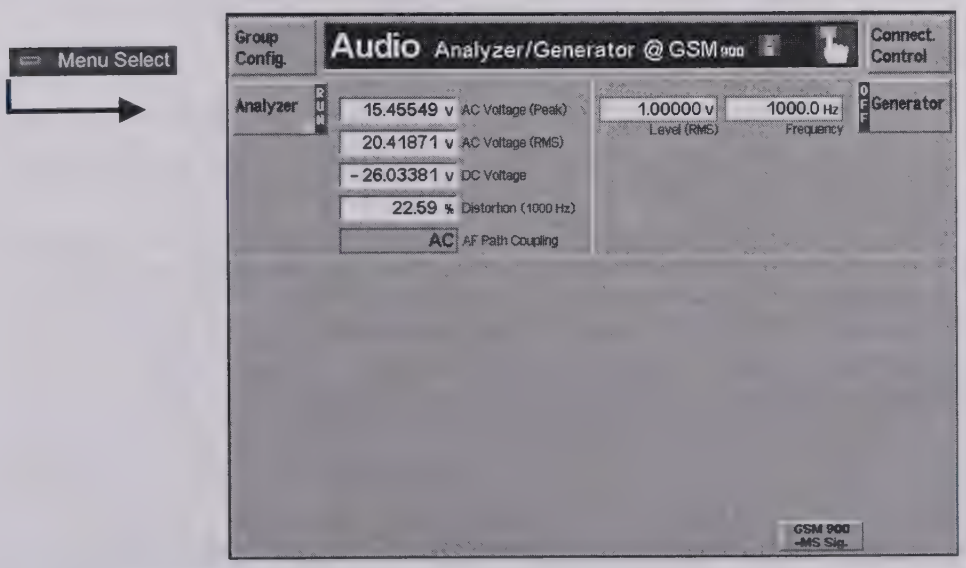


Fig. 4-25 Measurement menu Audio Analyzer/Generator

Analyzer

The *Analyzer* softkey controls the audio measurement *(RUN / HLT / OFF)* and indicates its status.

The measurement status can be changed by means of the *ON/OFF* key or the *CONT/HALT* key while the softkey is selected (press once). While the measurement is running, the measurement results are indicated and continuously updated in several output fields:

AC Voltage (Peak)	Peak value of the AC component of the measured AF signal in V.
AC Voltage (RMS)	Effective (RMS-averaged) value of the AC component of the measured AF signal in V.
DC Voltage	DC component of the measured AF signal in V
Distortion (xxx Hz)	Ratio of the measured AF signal with a notched-out reference frequency to the complete measured AF signal in percent. The reference frequency of the distortion measurement set in the *Distortion* tab of the configuration menu (see p. 4.46) is indicated in brackets. If the reference frequency is equal to the fundamental frequency of the AF signal, the *Distortion* value corresponds to the Total Harmonic Distortion and Noise. To avoid suppression of the first harmonic, the bandwidth of the notch filter is automatically adjusted to be smaller than the reference frequency.
AF Path Coupling	AF path coupling for combined AC/DC measurement *(DC)* or AC measurement *(AC)*, set in the *Control* tab of the configuration menu (see p. 4.45).

Measurement configuration

By pressing the selected *Analyzer* softkey for a second time the *Analyzer Configuration* popup-menu is opened; see p. 4.45.

Remote control

```
INITiate:AFANalyzer[:PRIMary]
STOP:AFANalyzer[:PRIMary]
ABORt:AFANalyzer[:PRIMary]
CONTinue:AFANalyzer[:PRIMary]

FETCh:AFANalyzer[:PRIMary]:STATus?

READ[:SCALar]:AFANalyzer[:PRIMary][:RESult]?
FETCh[:SCALar]:AFANalyzer[:PRIMary][:RESult]?
SAMPle[:SCALar]:AFANalyzer[:PRIMary][:RESult]?
```

Generator

The *Generator* softkey controls the audio generator *(ON / OFF)* and indicates its status.

The generator can be switched on or off by means of the *ON/OFF* key while the softkey is selected (press once). The parameters determining the generated sinusoidal audio signal can be set in two input fields:

Level (RMS)	Effective (RMS averaged) voltage of the AF signal
Frequency	Frequency of the AF signal

Remote control

```
INITiate:AFGenerator[:PRIMary]
ABORt:AFGenerator[:PRIMary]

FETCh:AFGenerator[:PRIMary]:STATus?

SOURce:AFGenerator[:PRIMary]:LEVel <Level>
SOURce:AFGenerator[:PRIMary]:FREQuency <Frequency>
```

GSM 900 –MS Sign.

The hotkey switches back to the previous GSM function group.

This hotkey is available if the *Audio Analyzer/Generator* menu was opened from a GSM function group. The hotkey is labeled with the calling function group and test mode, which is also displayed in the menu header.

Remote control `[SENSe:]POWer:FREQuency:CENTer <Frequency>`

Measurement Configurations (Analyzer Configuration)

The popup menu *Analyzer Configuration* contains two tabs that determine the parameters of the *Audio* measurement. It is opened by pressing the softkey *Analyzer* in the measurement menu *Audio Analyzer/Generator* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Analyzer Configuration – Control)

The *Control* tab determines:

- The *Repetition* mode,
- The *AF Path Coupling* of the audio measurement.

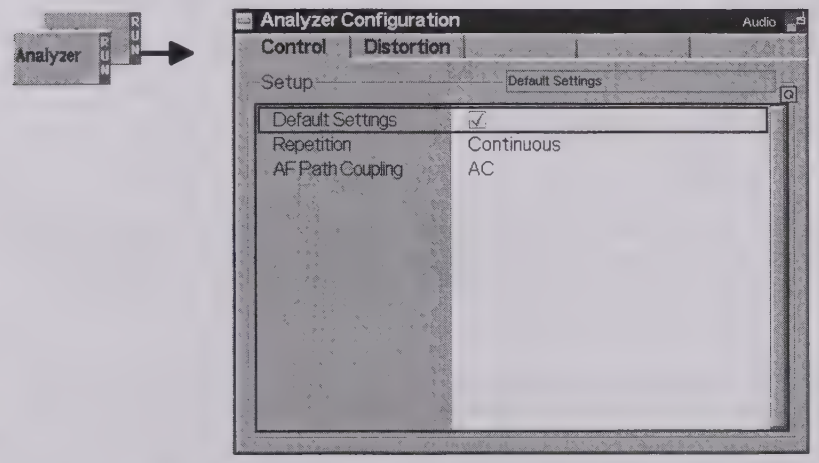


Fig. 4-26 Analyzer Configuration – Control

Default Settings The *Default* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control –

Repetition The *Repetition* field determines the repetition mode, see chapter 3 and explanations given on page 4.27 for the *Power vs. Time* measurement.

Remote control
```
CONFigure:AFANalyzer[:PRIMary]:REPetition
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

AF Path Coupling The *AF Path Coupling* field sets the input path for measurement of the AC or AC and DC component of the AF signal:

AC DC component of the measured AF signal (including a possible DC offset of the input amplifier) blocked. This ensures accurate measurement of the AC component. The DC component, however, can not be measured; the *DC Voltage* output field in the *Audio Analyzer/Generator* menu indicates "---".

DC Measurement of the complete AF input signal (DC plus AC components).

Remote control `CONFigure:AFANalyzer[:PRIMary]CONTrol:COUPling AC | DC`

Measurement Control (Analyzer Configuration – Distortion)

The *Control* tab determines the reference frequency of the distortion measurement.

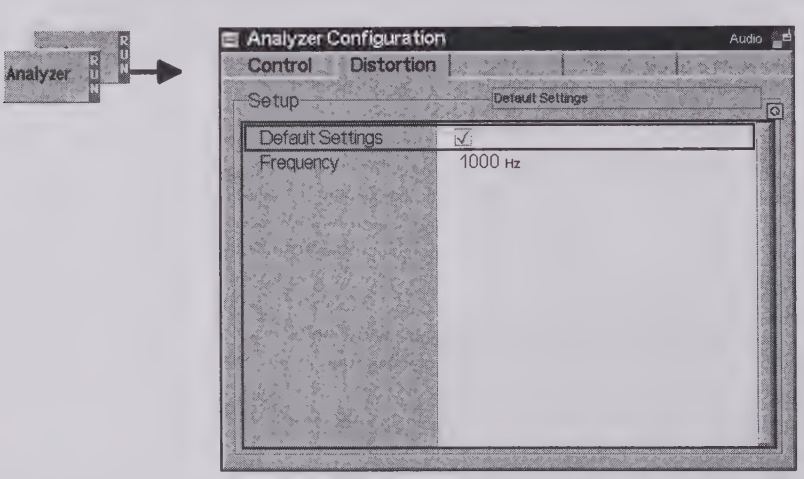


Fig. 4-27 Analyzer Configuration – Control

Default Settings The *Default Settings* switch assigns default values to all settings in the *Distortion* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control –

Frequency The *Frequency* field defines the reference frequency of the distortion measurement. If the reference frequency is set to the fundamental frequency of the AF signal, the *Distortion* value corresponds to the Total Harmonic Distortion and Noise.

Remote control `CONFigure:SPECtrum:CONTrol:REPetition`
`CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>`

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5 Remote Control - Basics

In this chapter you find:

- instructions how to put the CMU into operation via remote control,
- a general introduction to remote control of programmable instruments. This includes the description of the command structure and syntax according to the SCPI standard, the description of command execution and of the status registers,
- diagrams and tables describing the status registers used in the CMU.

In section *Special Terms and Notation* on page 5.39, concepts and terms relating to remote control of CMU in particular are discussed. In same chapter 6, all *remote* control functions of the basic unit and of function group *RF Analyzer* are described in detail. For each group of measurements or configurations, all commands and their parameters are listed by alphabetical order in the command list at the end of chapter 6.

Program examples for the CMU can be found in chapter 7.

Introduction

The instrument is equipped with an GPIB bus interface according to standard IEC 625.1/IEEE 488.1. The connectors are located at the rear of the instrument and permit to connect a controller for remote control.

This section assumes basic knowledge of GPIB bus programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

Not all of the commands supported by the instrument are taken from the SCPI standard (Standard Commands for Programmable Instruments), however, their syntax follows SCPI rules. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers (see section *SCPI Introduction*).

The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

Note: *In contrast to instruments with manual control, which are designed for maximum possible operating convenience, the priority of remote control is the "predictability" of the device status. This means that when incompatible settings are attempted, the command is ignored and the device status remains unchanged, i.e. other settings are not automatically adapted. Therefore, GPIB bus control programs should always define an initial device status (e.g. with the command *RST) and then implement the required settings.*

Operation via Remote Control

As any device, the CMU must be assigned a unique primary address in the range 0 to 30 decimal. In addition it uses extended addressing, i.e. a secondary address must be assigned to the individual function groups. Primary and secondary addresses can be defined in the *Remote* index card of the *Setup* menu (see chapter 4) or via remote control.

Switchover to Remote Control

On power-on, the instrument is always in the manual operating state and can be operated via the front panel controls. The instrument is switched to remote control in the following cases:

With active GPIB bus	as soon as the Remote Enable (REN) GPIB line is asserted by the controller.
With active RS-232 interface	as soon as the instrument receives any characters via the interface.

Operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via GPIB bus (see section *Return to Manual Operation)*. Switching from manual operation to remote control does not affect the device settings.

Setting the Device Address

The GPIB address (primary address) of the instrument is factory-set to 20. It can be changed manually via the *Primary Address* softkey in the *Setup - Remote* menu or via GPIB bus. For remote control, addresses 0 through 30 are permissible.

In addition to the primary address, up to 30 secondary addresses can be assigned to the individual function groups. The secondary address is set via the *Second. Address* softkey in the *Setup - Remote* menu or via remote control.

Note: *In the Setup – Remote menu, secondary addresses between 1 and 30 can be assigned. For reasons of compatibility with the National Instruments driver, the secondary addresses used for remote control must be in the range between 96 and 125 decimal.*

Changing the addresses manually:

- Call *Setup - Remote* menu.
- Press *Primary Address* softkey. Enter desired address in the input field.
- Press *Second. Address* softkey. Use the rotary knob to select the list line with the desired address (numbers 1 to 30). Press ENTER to edit the line. From the popup window select the desired function group (use the rotary knob to change between the entries in the popup window). Confirm your selection and close the popup window using the ENTER key.
- Press the *ESCAPE* key to close the *Setup – Remote* menu.

Via GPIB bus interface:

- Use the `SYSTem:REMote:ADDRess:PRIMary <Addr_1>` command to define the GPIB bus address of the CMU.
- Use the `SYSTem:REMote:ADDRess:SECondary <Addr_2>,"<Fgroup>"` command to assign distinct secondary addresses to all function groups needed. The secondary address is transferred with each command (physical/hardware addressing, see program example in chapter 7). Alternatively, software switchover with a command preceded by a secondary address and a semicolon is possible:

  `<Addr_2>;<Command>` (logical addressing of secondary address; use semicolon)

Via RS-232 interface:

- Use the `SYSTem:REMote:ADDRess:PRIMary <Addr_1>` command to define the GPIB bus address of the CMU.
- Use the `SYSTem:REMote:ADDRess:SECondary <Addr_2>,"<Fgroup>"` command to assign distinct secondary addresses to all function groups needed.
- Use the `*SEC <Addr_2>` command for a software switchover from one secondary address to another. Alternatively place `<Addr_2>;` in front of the command:

  `*SEC <Addr_2>` followed by `<Command>` is equivalent to `<Addr_2>;<Command>`, provided that secondary address `<Addr_2>` has been appropriately defined.

Indications during Remote Control

In the REMOTE state no menus but only the header REMOTE is indicated. In addition, input and output strings of the remote-control interface can be displayed by pressing the *Report* hotkey. The *Local* hotkey switches back to manual control.

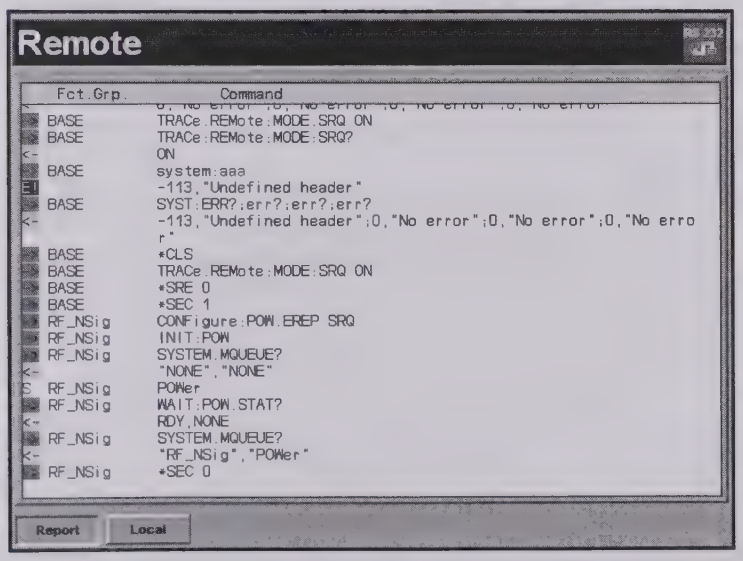


Fig. 5-1 Remote screen

Return to Manual Operation

Return to manual operation can be initiated via the front panel or the GPIB bus.

Manually:

- Press any key at the front panel.

Note:

- *Before returning to manual control, command processing must be completed. If this is not the case, the CMU switches back to remote control immediately.*
- *Returning to manual control by pressing any front panel key can be disabled by the GPIB Local Lockout Message, e.g. with the NI command SetRWLS*

(Set Remote With Lockout State). This prevents unintentional switchover, i.e. return to manual control is possible via the GPIB bus only.

– *Returning to manual control via the front panel keys can be enabled again by deactivating the REN control line of the GPIB bus (see chapter 8).*

Via GPIB bus:

```
...
CALL IBLOC(device%)          Set instrument to manual operation
...
```

Setting the Transmission Parameters (RS-232 interface)

To ensure a correct data transmission, the parameters of the instrument and the controller must be set identically. The number of data and stop bits, the parity, baud rate and the handshake mode can be set independently for the two interfaces COM 1 and COM 2 in the *Setup - Comm.* menu:

- Open *Setup - Comm.* menu,
- Press one of the softkeys to select interface COM 1 or COM 2,
- Use the cursor keys and the rotary knob to select and change desired parameters,
- Terminate input using the *[ENTER]* key.

GPIB Bus Messages

The messages transferred via the data lines of the GPIB bus (see chapter 8) can be divided into two groups:

- **interface messages**
- **device messages**

Interface Message

Interface messages are transferred on the data lines of the GPIB bus, the ATN control line being active. They are used for communication between controller and instrument and can only be sent by a computer which has the function of an GPIB bus controller.

Interface commands can be further subdivided into

- **universal commands**
- **addressed commands**

Universal commands act on all devices connected to the GPIB bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in chapter 8, section *Interface Messages*.

Device Messages (Commands and Device Responses)

Device messages are transferred via the data lines of the GPIB bus, the "ATN" control line not being active. The ASCII code is used. A distinction is made according to the direction in which device messages are transferred:

Commands are messages the controller sends to the instrument. They operate the device functions and request information. The commands are subdivided according to two criteria:

1. According to the effect they have on the instrument:

   Setting commands cause instrument settings such as a reset of the instrument or setting the output level to some value.

   Queries cause data to be provided for output on the GPIB bus, e.g. for identification of the device or polling the active input.

2. According to their definition in standard IEEE 488.2:

   Common Commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and selftest.

   Device-specific Commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee (cf. section *SCPI Introduction*).

Device responses are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. section 3.5.4).

Structure and syntax of the device messages are described in the next section. In chapter 6 all commands are listed and explained in detail.

Structure and Syntax of Device Messages

SCPI Introduction

Not all of the commands supported by the instrument are taken from the SCPI standard (Standard Commands for Programmable Instruments), however, their syntax follows SCPI rules. All information given in this section and all the command examples apply to the CMU.

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure. Fig. 5-2 illustrates this tree structure using a section of command system SOURce, which operates the signal sources of the devices. The other examples concerning syntax and structure of the commands are derived from this command system.

SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see section *Responses to Queries*).

Command Structure

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk "*" and eventually one or several parameters.

Examples:

`*RST`	RESET, resets the instrument.
`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable registers.
`*ESR?`	EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy: Device-specific commands are of hierarchical structure (see Fig. 5-2). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example:

`SOURce` This key word denotes the command system `SOURce`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example:

```
SOURce:RFGenerator:FHOPping:STATe ON
```

This command is located on the fourth level of the SENse system. It switches on frequency hopping for the RF generator.

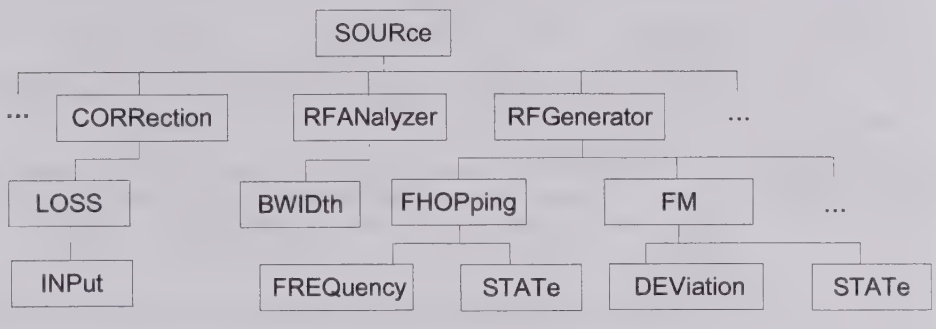


Fig. 5-2 Example for the tree structure of the SCPI command systems; the `SOURce` system

Multiple key words

Some key words occur on several levels within one command system. Their effect depends on the structure of the command, i. e. on the position in the command header they are inserted in.

Example: `SOURce:RFGenerator:FHOPping:STATe ON`

This command contains the key word `SOURce` in the first command level. It switches on frequency hopping for the RF generator.

`TRIGger:SOURce EXTern`

This command contains the key word `SOURce` in the second command level. It defines the trigger source "external trigger".

Optional key words:

Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in this manual. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by omitting optional key words.

Example: `TRIGger[:SEQuence]:SOURce EXTern`

This command defines the trigger source "external trigger". The following command has the same effect:

`TRIGger:SOURce EXTern`

Note: *An optional key word must not be omitted if its effect is additionally specified by a numeric suffix.*

Long and short form:

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Example: `TRIGger:SOURce EXTern`
`TRIG:SOUR EXT`

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serves to distinguish the two forms in the manual, the instrument itself does not distinguish upper-case and lower-case letters.*

Parameters: Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". For a description of the types of parameter, refer to section *Parameters* on page 5.9.

Example: `CONFigure:POWer:CONTrol SCALar,100`

This command defines the type of measured values in a power measurement and the number of samples/bursts forming a statistics cycle.

Numeric suffix: If a device features several functions or features of the same kind, e.g. several inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example: `SOURce:CORRection:LOSS:INPut2 10dB`

This command defines the external attenuation at the input connector RF 2

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. Visual BASIC automatically produces an EOI together with the last data byte.

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example: `CALL IBWRT(device%, "TRIGger:SOURce EXTern;:FETch:POWer:STATus?")`

This command line contains two commands. The first command belongs to the `TRIGger` system and defines the trigger source (external trigger). The second command belongs to the `FETCh` system and returns the status of the power measurement.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 5.1). The colon following the semicolon must be omitted in this case.

Example: `CALL IBWRT(device%, "TRIG:SOUR EXT;:TRIG:THR LOW")`

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the `TRIGger` command system, i.e. they have one level in common.
When abbreviating the command line, the second command begins with the level below `TRIG`. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

`CALL IBWRT(device%, "TRIG:SOUR EXT;THR LOW")`

However, a new command line always begins with the complete path.

Example: `CALL IBWRT(device%, "TRIG:SOUR EXT ")`
`CALL IBWRT(device%, "TRIG:THR LOW ")`

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter is transmitted without header.
   Example: `TRIGger:THReshold?` Response: `LOW`
2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values
   Example: `CONFigure:POWer:CONTrol:REPetition? MAX` Response: `10000`
3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
   Example: `SENSe:SPECtrum:FREQuency:STARt?` Response: `1E6` for 1 MHz
4. Boolean values are returned as 0 (for OFF) and 1 (for ON).
   Example: `INPut:STATe?` Response: `1`
5. Text (character data) is returned in a short form (see also next section).
   Example: `FETCh:SPECtrum:STATus?` Response: `ERR`

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description.

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used (see also section *Unit Rings* below).

Example: `SENS:SPEC:FREQ:STOP 1.5GHz` is equivalent to
`SENS:SPEC:FREQ:STOP 1.5E9`

Special numerical values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the associated numerical value is provided.

Example: Setting command: `CONF:POW:CONT:REP MAXimum`
Query: `CONF:POW:CONT:REP?`
Response: `100`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes a preset value. This value conforms to the default setting, as it is called by the *RST command.

INF/NINF — INFinity, Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device responses.

NAN — Not a Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are division of zero by zero, subtraction of infinite from infinite and the representation of missing values.

Boolean Parameters — Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. ON or OFF is provided in a query.

Example: Setting command: `INPut:STATe ON`
Query: `INPut:STATe?`
Response: `ON`

Text — Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example: Setting command: `TRIGger:SOURce EXTern`
Query: `TRIGger:SOURce?` Response: `EXT`

Strings — Strings must always be entered within quotation marks (' or ").

Example: `:SYST:REM:ADDR:SEC 1,"GSM900MS_NSig"` or
`:SYST:REM:ADDR:SEC 1,'GSM900MS_Nsig'`

Block data — Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example: `:HEADer:HEADer #45168xxxxxxxx`

The double dagger # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted.

Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

:	The colon separates the key words of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The double dagger # introduces binary, octal, hexadecimal and block data. Binary: #B10110 Octal: #O7612 Hexa: #HF3A7 Block: #21313...
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

Instrument Model and Command Processing

The block diagram in figure Fig. 5-3 shows how GPIB bus commands are serviced in the instrument. The individual components work independently and simultaneously. They communicate with each other by means of so-called "messages".

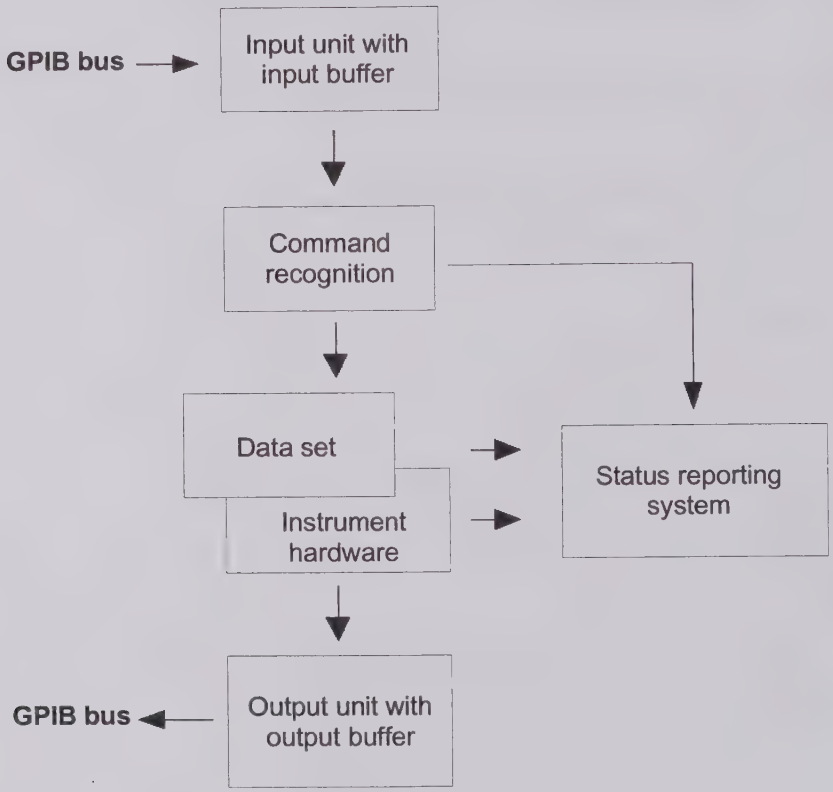


Fig. 5-3 Instrument model in the case of remote control via GPIB bus

Input Unit

The input unit receives commands character by character from the GPIB bus and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.

If the input buffer is full, the GPIB bus traffic is stopped and the data received up to then are processed. Subsequently the GPIB bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before. Each recognized command is immediately transmitted to the data set but not executed immediately.

Syntactical errors in the command are recognized here and transferred to the status reporting system. The rest of a command line after a syntax error is ignored.

If the command recognition recognizes a delimiter or a DCL, it requests the data set to set the commands in the instrument hardware as well. Subsequently it is immediately prepared to process commands again. This means for the command servicing that further commands can already be serviced while the hardware is still being set ("overlapping execution").

Data Set and Instrument Hardware

The expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included.

The data set is a detailed software reproduction of the instrument hardware.

GPIB bus setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. As this is always only effected at the end of a command line, the order of the setting commands in the command line is not relevant.

The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that execution is not possible, an "execution error" is signaled to the status reporting system. All alterations of the data set are canceled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, impermissible instrument states can be set for a short period of time within one command line without this leading to an error message (example: simultaneous activation of FM and PM). At the end of the command line, however, a permissible instrument state must have been reached again.

Before passing on the data to the hardware, the settling bit in the STATus:OPERation register is set (cf. section *STATus:OPERation* Register). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

GPIB bus queries induce the data set management to send the desired data to the output unit.

Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in section Status Reporting System on page 5.15.

Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer. If the information requested is longer, it is made available "in portions" without this being recognized by the controller.

If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the GPIB bus, the controller waits until it has reached its time limit. This behavior is specified by SCPI.

Command Sequence and Command Synchronization

What was said above makes clear that overlapping execution is possible in principle for all commands. Equally, setting commands within one command line are not absolutely serviced in the order in which they have been received.

In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line, that is to say, with a separate IBWRT()-call.
In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By a suitable programming, the controller can be forced to wait for the respective action to occur (cf. Table 5-1).

Table 5-1 Synchronization with *OPC, *OPC? and *WAI

Command	Action after the hardware has settled	Programming the controller
*OPC	Setting the operation-complete bit in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	Executing the next command Note: The GPIB bus handshake is not stopped	Sending the next command

Status Reporting System

The status reporting system (cf. Fig. 5-5) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out an AUTORANGE and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via GPIB bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 5-5.

Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 5-4). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

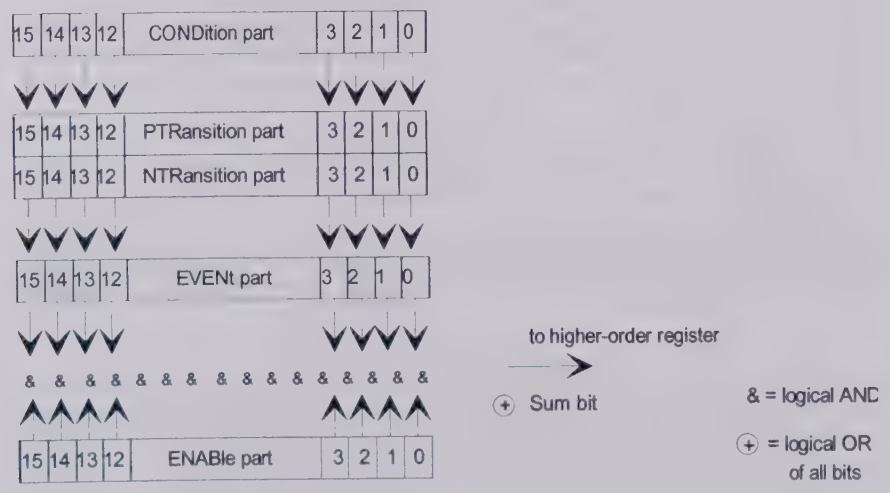

15 14 13 12 CONDition part 3 2 1 0
15 14 13 12 PTRansition part 3 2 1 0
15 14 13 12 NTRansition part 3 2 1 0
15 14 13 12 EVENt part 3 2 1 0
& & & & & & & & & & & & & &
15 14 13 12 ENABle part 3 2 1 0
to higher-order register
Sum bit
& = logical AND
= logical OR of all bits

Fig. 5-4 The status register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as an edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
PTR bit =1: the EVENt bit is set.
PTR bit =0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as an edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR bit =1: the EVENt bit is set.
NTR bit =0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part

The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. Upon reading, its contents is set to zero. In colloquial language, this part is often equated with the entire register.

ENABle part

The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').
ENAB bit =0: the associated EVENt bit does not contribute to the sum bit
ENAB bit =1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit

As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.
The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note:

The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.

Overview of the Status Registers

Fig. 5-5 shows the status registers used in the CMU. The STATus:QUEStionable register is not used. In addition to the standard STATus:OPERation register, the CMU offers 30 independent STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers (<nr>=1 ... 15).

Cascading registers

The hierarchical structure of the STATus:OPERation register was designed with the aim of reporting and specifying the events generated during different measurements independently. Each sub-register receives entries from a particular combination of a function group and signalling mode (e.g. *RF Non Signalling, GSM900-MS Signalling* etc.). The function groups and modes are identified by means of their secondary address, an integer number between 1 and 30 which can be arbitrarily assigned or queried via the `SYSTem:REMote:ADDRess:SECondary` command (see chapter 6). The assignment between sub-registers and secondary address is as follows:

Sub-register	Sec. Address	Sub-register	Sec. Address
STAT:OPER:SUM1:CMU1	1	STAT:OPER:SUM2:CMU1	16
...	...	...	...
STAT:OPER:SUM1:CMU15	15	STAT:OPER:SUM2:CMU15	30

Contents of the sub-registers

The higher-level STATus:OPERation registers summarize the sub-registers as shown in Fig. 5-5. E.g., if the corresponding ENABle bit is set, any EVENt reported in one of the STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers sets the sum bit of the STATus:OPERation:CMU:SUM1|2 register to 1.

This means that the STATus:OPERation register indicates whether any event occurred, the lower-level STATus:OPERation:CMU:SUM1|2 registers indicate the function group and signalling mode in which the event occurred, the lowest-level STATus:OPERation:CMU:SUM1|2 registers indicate the nature of the individual events.

The meaning of the bits in function group *RF Non Signalling* is given below (see section STATus:OPERation Register 5.21). For other function groups refer to the relevant manuals.

Accessing the sub-registers

Every single status register can be configured and queried individually by means of the commands of the STATus:OPERation subsystem (see chapter 6).

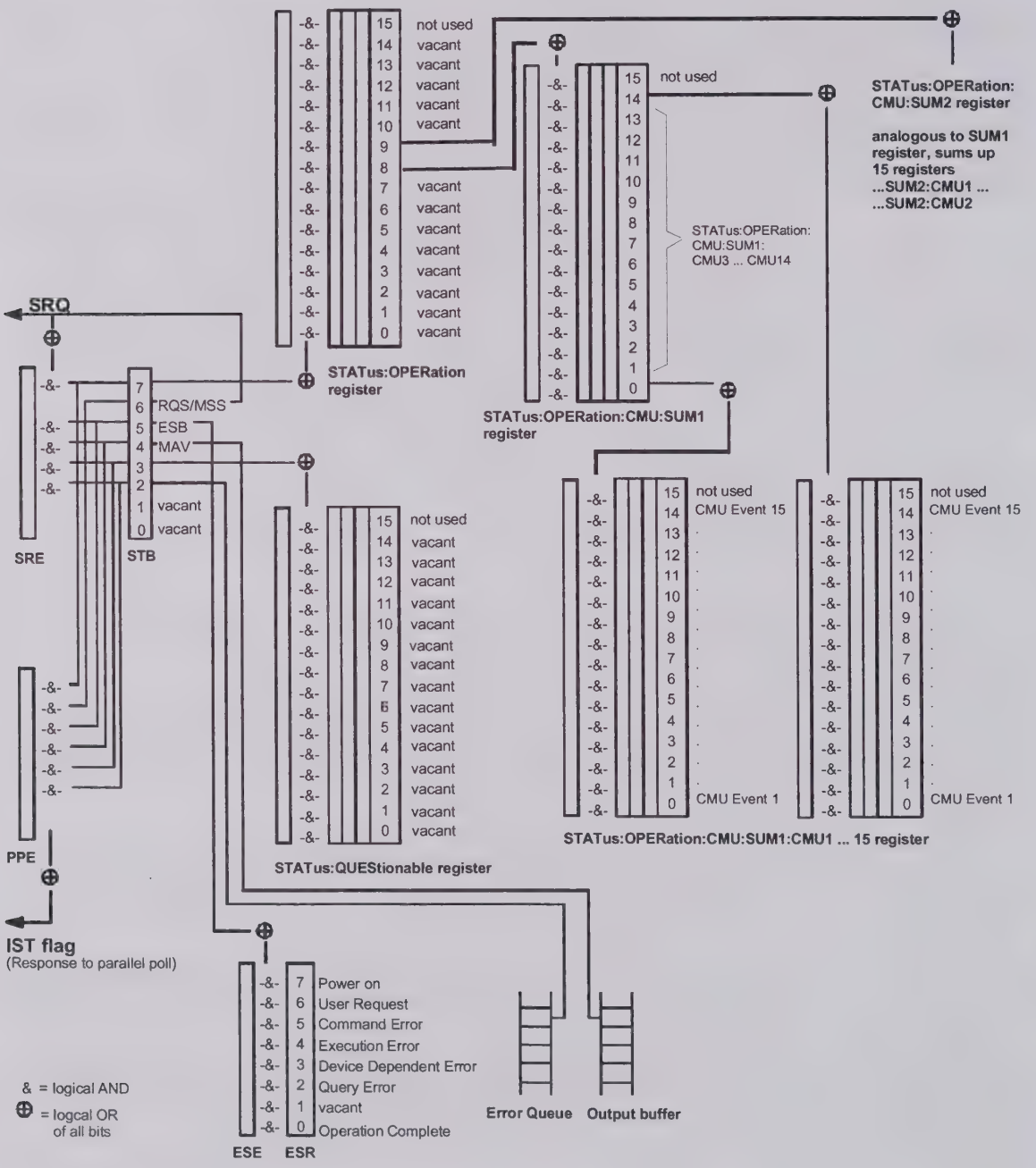


Fig. 5-5 The status registers

Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STATUS BYTE is read out using the command "*STB?" or a serial poll.

The STB is linked to the SRE. The latter corresponds to the ENABle part of the SCPI registers in its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the GPIB bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command "*SRE" and read using "*SRE?".

Table 5-2 Meaning of the bits used in the status byte

Bit no.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with GPIB bus control.
3	**QUEStionable status sum bit** The bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable status register.
4	**MAV-Bit** (Message AVailable) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. annex D, program examples).
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	**MSS-Bit** (Master Status Summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be queried by polling the OPERation status register.

IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. Section *Parallel Poll* on page 5.24) or using the command "*IST?".

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "*PRE?".

Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "*ESR?".
The ESE is the associated ENABle part. It can be set using the command "*ESE" and read using the command "*ESE?".

Table 5-3 Meaning of the bits used in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
6	**User Request** This bit is not used in the CMU.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

The CMU offers 30 independent STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers (<nr>=1 ... 15) which are implemented in hierarchical form. The bits of the 30 STATus:OPERation registers are set only after the registers are assigned to a function group and measurement mode (see p. 5.17).

In the CONDition part, the STATus:OPERation register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last readout. All fife parts of the registers can be read using one of the commands of the subsystem `STATus:OPERation:CMU:SUM1|2:CMU<nr>:...` . Moreover, the EVENt part can be enabled and read by means of the `STATus:OPERation:SYMBolic...` commands, see section

Symbolic Status Event Register Evaluation on page 5.24 ff.

For function group *RF Non Signalling*, the bit assignment is as follows:

Table 5-4 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-register assigned to *RF Non Signalling*

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
0	**Overload** This bit is set while the currently used input connector is overloaded.	**IOV**

For optional function groups refer to the relevant manuals.

STATus:QUEStionable-Register

This register contains information on questionable instrument states. They can occur, e.g. if the instrument is operated outside its specified range. It can be queried using one of the commands `":STATus:QUEStionable:CONDition?"` or `":STATus:QUEStionable[:EVENt]?"`.

The CMU does not use this register.

Application of the Status Reporting Systems

In order to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are outlined in the following.

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from Fig. 5-5, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The corresponding setting of the ENABle parts of the status registers can achieve that arbitrary bits in an arbitrary status register initiate an SRQ. In order use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Examples (cf. Fig. 5-5):

Use command "`*OPC`" to generate an SRQ

- Set bit 0 in the ESE (Operation Complete)
- Set bit 5 in the SRE (ESB)

After its settings have been completed, the instrument generates an SRQ.

Indication of an event (e.g. overloading of used input connector) by means of an SRQ with the controller:

- Set bit 7 in the SRE (sum bit of the STATus:OPERation register)

The following steps depend on the secondary address (1 ≤ <SecAddr> ≤ 30) assigned to the function group and signalling mode used.

1 ≤ <SecAddr> ≤ 15

- Set bit 8 in the STATus:OPERation:ENABle register.
- Set bit <SecAddr>-1 in the STATus:OPERation:CMU:SUM1:ENABle register
- Set bit 0 in the STATus:OPERation:CMU:SUM1:CMU<Sec Addr>:ENABle register.

16 ≤ <SecAddr> ≤ 30

- Set bit 9 in the STATus:OPERation:ENABle register.
- Set bit <SecAddr>-16 in the STATus:OPERation:CMU:SUM2:ENABle register
- Set bit 0 in the STATus:OPERation:CMU:SUM2:CMU<Sec Addr>:ENABle register.

When the event assigned to bit no. 0 of the STATus:OPERation:CMU:SUM1|2:CMU<SecAddr> register occurs (e.g. when the input connector is overloaded in function group *RF Non Signalling)* the instrument generates a SRQ.

The same procedure can be applied to find out which event caused an SRQ:

- `STB?`
- Query `STAT:OPER:EVENT?`
- Query `STAT:OPER:CMU:SUM1|2:EVENT?` (function group, signalling mode)
- Query `STAT:OPER:CMU:SUM1|2:CMU1...15:EVENT?` (measurement)

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Symbolic Status Event Register Evaluation

The examples status register handling given in section *Service Request* on p. 5.23 are based on a step-by-step evaluation of the STATus:OPERation register and its sub-registers. As a convenient alternative to this approach, the CMU provides commands for symbolic status event register evaluation. These commands are global (i.e. available in all function groups) and described in detail in chapter 6. They organize and simplify the following actions:

`STATus:OPERation:EVENt:SADDress?`
Return the next secondary address and associated function group where an event was reported.

`STATus:OPERation:SYMBolic:ENABle <Event_1>[,<Event_2>,...<Event_15>]`
Enable the events of the parameter list up to the status byte, i.e. set the corresponding bits in the STATus:OPERation:ENABle register and in the sub-registers STATus:OPERation:CMU:SUM1|2:ENABle and STATus:OPERation:CMU:SUM1|2:CMU <SecAddr>:ENABle so that the events are reported in the status byte. <SecAddr> denotes the current secondary address, see also example in section *Service Request* on p. 5.23.

`STATus:OPERation:SYMBolic[:EVENt]?`
Return all events reported in the current function group. The event symbols listed with the bit assignment of the STATus:OPERation... registers; for an example see Table 5-4 on page 5.22.

Serial Poll

In a serial poll, just as upon the command "*STB", the status byte of an instrument is queried. However, the query is made via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The quick-BASIC command for executing a serial poll is "IBRSP()". The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the GPIB bus.

Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller by means of a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logic "0" or "1". By analogy to the SRE register which determines under which conditions an SRQ is generated, there is a parallel poll enable register (PPE) which is ANDed with the STB bit by bit, considering bit 6 – AND as well. The results are ORed, the result is then sent (possibly inverted) as a response to the parallel poll of the controller. The result can also be queried without parallel poll by means of the command "*IST".

The instrument first has to be set for the parallel poll using the quick-BASIC command "IBPPC()". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "IBRPP()".

The parallel-poll method is mainly used in order to quickly find out after an SRQ which instrument has sent the service request if there are many instruments connected to the GPIB bus. To this effect, SRE and PPE must be set to the same value.

Query by Means of Commands

Each part of any status register can be read by means of queries. The individual commands are listed in chapter 6. What is returned is always a number which represents the bit pattern of the register queried. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be looked at in the ERROR menu via manual control or queried via the GPIB bus using command `"SYSTem:ERRor?"`. Each call of `"SYSTem:ERRor?"` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

Reset Values of the Status Reporting Systems

Table 5-5 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for *RST and SYSTem:PRESet influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 5-5 Resetting instrument functions

Event	Switching on supply voltage		DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
	Power-On-Status-Clear					
Effect	0	1				
Clear STB,ESR	—	yes	—	—	—	yes
Clear SRE,ESE	—	yes	—	—	—	—
Clear PPE	—	yes	—	—	—	—
Clear EVENt parts of the registers	—	yes	—	—	—	yes
Clear ENABle parts of all OPERation-and QUESTionable registers, Fill ENABle parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with „1" Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e. immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

Measurement Control

The CMU offers a variety of measurements which are arranged in function groups and measurement groups. All measurements are controlled according to the same basic concepts. The benefit of this structure lies in the close analogy of all function groups. Commands belonging to different measurements have the same structure and syntax.

The following sections are devoted to the principles of measurement control:

- A measurement group can be split up into different subgroups by means of *applications* (optional, i.e. not available for every measurement group).
- Four different measurement states are defined; they can be accessed with a set of measurement control commands.
- The end of the measurement (or of a particular measurement stage) can be indicated by means of *the event reporting system*.
- Statistical settings comprising the repetition mode, statistic count (optional), stop condition (optional), and display mode (optional) control how the measurement is performed. The possible measurement states depend on the repetition mode.
- The current status and the results of the measurement can be queried in a systematic way.

Some measurements do not require the full scheme. E.g., the function group *RF Non Signalling* described in this manual uses none of the features characterized as optional in the above enumeration. Examples for these features can be found in the operating manuals for digital network tests, e.g., *GSM900/1800/1900-MS*.

Applications

Applications are different measurements belonging to the same measurement group. Each application is assigned its own set of configuration parameters. With few exceptions (e.g. some tolerance values), all parameters assigned to the applications can be different from each other. Thus, applications effectively split up a measurement group into various independent subgroups which can be configured individually and serviced in parallel.

The benefit of this feature is that the results of an application will not become invalid when another application in the same measurement group is started.

Applications are generally identified by the third-level keyword in a command while the measurement group is identified by the second-level keyword. Examples can be found in the operating manuals for the network tests.

Measurement Control Commands and States

Measurement control commands are used to switch over between the following four measurement states:

OFF	measurement is switched off, no results available (after `STOP`)
RUN	measurement is running
STOP	measurement has been stopped, valid results are preserved
STEP	measurement has been interrupted after a statistics cycle (in repetition mode *Continuous* or *Counting* with *Stepping* mode set in addition). The next cycle must be launched with a `CONTinue` command.

The *STOP* state corresponds to the *HLT* state indicated next to the softkeys controlling a measurement in manual operation. A *STEP* state is not defined in manual control.

The three measurement states *OFF, STOP,* and *STEP* can be mapped onto the standard SCPI state *IDLE*, the *RUN* state can be mapped onto the SCPI state *INITiated*. This and the relation between control commands and measurement states is shown in the following diagram:

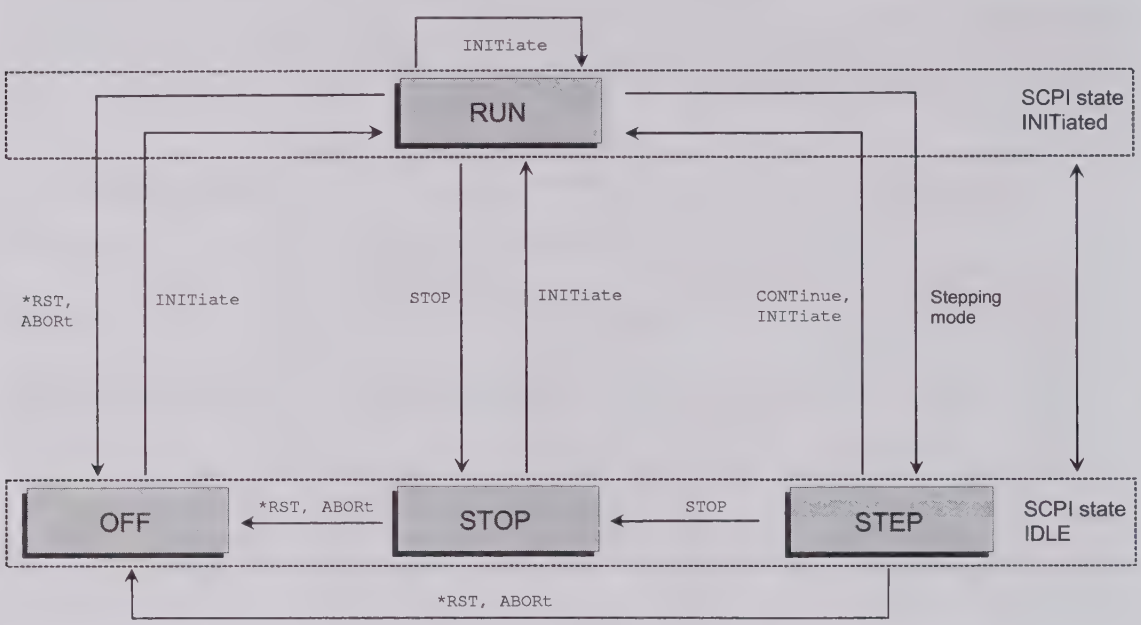


Fig. 5-7 Measurement states and control commands

The measurement control commands are supplemented by the measurement object, i.e.:

INITiate:<meas_obj> Starts a measurement in the repetition mode set via the CONFigure:<meas_obj>:CONTrol:REPetition command (single shot, continuous or counting mode, see section *Measurement Statistics* on page 5.33). The command resets the counters for the evaluation period and statistics (the latter is not used in RF measurements) to zero, furthermore, all measurement values are set invalid *(INV)*.

As illustrated in Fig. 5-7, INITiate can be called in any measurement state. If the measurement is already running *(RUN)*, INITiate aborts (ABORt) and restarts a running measurement.

The measurement reserves all necessary hardware resources and switches into the *RUN* state. If the measurement can not be started due to a resources conflict it remains in the *OFF* state, and the measurement status returned by the FETCh:<meas_obj>:STATus? is *ERR*. At the same time the SCPI error –213, *Init ignored*, is generated.

Possible resources conflicts

The RF connector is already allocated by another measurement or signal generator. The other measurement must be switched off first.

Due to the method used for the analysis, two measurements can not be evaluated at the same time.

Overlapping execution

INITiate is implemented as an overlapped command. In contrast to SCPI specifications, the *OPC command (see chapter 6, *Common Commands)* can not be applied together with the INITiate command. The *operation complete* bit (bit no. 0 in the event status register, ESR) is set

immediately after the command sequence INIT; *OPC, i.e. as soon as the measurement is started and not after the end of the first evaluation period.

The command CONFigure:<meas_obj>:EREPorting <Event>, <Mode> represents a more flexible tool for generating a service request or setting the *operation complete* bit after the end of a measurement (see section *Event Reporting* on page 5.30).

READ command

Instead of INITiate, the READ command can be used to initiate a (single shot) measurement, see section *Retrieving Measurement Results* on page 5.33.

ABORt:<meas_obj>

Aborts the current measurement immediately and switches over to the *OFF* state. All measurement values are set invalid *(INV);* the hardware resources are released for other measurements.

As illustrated in Fig. 5-7, ABORt can be called in any measurement state.

Sequential execution

ABORt is implemented as a sequential command. This means that ABORt ist not complete until the measurement has released all resouces and has changed to the *OFF* state.

STOP:<meas_obj>

Stops (halts) the measurement as quickly as possible; i.e. after the end of the current evaluation period (or statistics cycle, if cycles comprising several evaluation periods are defined). The measurement changes to the *STOP* state such that all corresponding measurement values are kept unchanged. The hardware resources are retained.

As illustrated in Fig. 5-7, STOP can be called in the measurement states *RUN* and *STEP*. If called in the *OFF* state the command causes an SCPI error –221, *Settings conflict*.

Sequential execution

STOP is implemented as a sequential command. Execution of STOP is considered as complete as soon as the measurement state *STOP* is reached.

The STOP command causes no events which are set by the event reporting system (see section *Event Reporting* on page 5.30). This means that a service request must be explicitly requested by an *OPC command.

CONTinue:<meas_obj>

Resumes the measurement for the next measurement evaluation period and changes to the *RUN* state.

As illustrated in Fig. 5-7, CONTinue can be called in the measurement states *STOP* and *STEP*. If the previous measurement has been terminated (the measurement status returned by the FETCh:<meas_obj>:STATus? is *RDY),* CONTinue restarts the measurement and resets the counters for the evaluation period and statistics (the latter is not used for RF measurements) to zero.

In the other measurement states the command causes an SCPI error –221, *Settings conflict*.

Overlapping execution

CONTinue is implemented as an overlapping command like INITiate. As a consequence, *OPC can not be used together with CONTinue.

Stepping mode

The stepping mode determines whether a measurement in the *counting* or *continuous* mode (see section *Measurement Statistics* on page 5.33) is interrupted after each evaluation period (or each statistics cycle, if cycles comprising several evaluation periods are defined) or not. The mode is set via the <Stepmode> parameter of the CONFigure:<meas_obj>:CONTrol:REPetition CONTinuous | 1 ... 10000, <StopCondition>, <Stepmode> command:

<Stepmode> = STEP — The measurement is interrupted (measurement state *STEP)* after each evaluation period, and the event reporting system (see p. 5.30) is invoked. The next measurement cycle must be started with the CONTinue:<meas_object> command.

<Stepmode> = NONE — The measurement runs according to its repetition mode. Event reporting is invoked only when the measurement stops (status = RDY).

Note: *STEP can be set in all repetition* modes (single shot, continuous, counting). *For a single shot measurement which is always stopped after one evaluation period, the stepping mode has no effect.*

In function group *RF Non Signalling*, <meas_obj> can stand for any of the measurement objects POWer and SPECtrum.

Event Reporting

The event reporting system specifies in which way the CMU reports that a measurement or a measurement step has been correctly terminated, i.e., that the measurement status *STEP* or *RDY* has been reached. Event reporting is configured for each measurement group individually by means of the commands

CONFigure:<meas_obj>:EREPorting SRQ | SOPC | SRSQ | OFF

The parameters have the following meaning:

SRQ — Service request. A service request is generated (i.e. bit no. 6 (RQS/MSS) of the status byte (STB) is set) whenever the measurement status *STEP* or *RDY* is reached (see section *Service Request* on page 5.23).

SOPC — Single operation complete. The *operation complete* bit (bit no. 0 in the event status register) is set whenever the measurement status *STEP* or *RDY* is reached (see section *Status Reporting System* on page 5.15).

SRSQ — A service request is generated and the *operation complete* bit is set.

OFF — No special action is taken when the measurement status *STEP* or *RDY* is reached.

Note: *No action is taken if the* STOP *state is reached due to an explicit STOP command.*

Symbolic Measurement Ready Evaluation:

If event reporting is enabled (i.e. CONFigure:<meas_obj>:EREPorting is not set to OFF), each measurement that reaches the *STEP* or *RDY* status causes an entry in the *measurement queue*. The measurement queue can be queried by means of the SYSTem:MQUeue[:COMPlete]<spec>? commands described in chapter 6. Two different specifiers are provided:

<spec> = [:LIST] — Return the complete list of all ready measurements and reset all entries in the measurement queue to *NONE*.

<spec> = :ITEM Return the next ready measurement in the list and reset the corresponding entry in the measurement queue to *NONE*.

Symbolic measurement ready evaluation is in order, e.g. to avoid inconsistencies when a FETCh...? command is used to retrieve measurement results (see section *Retrieving Measurement Results* on page 5.33).

Measurement Status

The status of the current measurement can be queried by means of the following command:

FETCh status FETCh:<meas_obj>:STATus?

Return the current status of the measurement. The FETCh... command can be used as well to poll the progress of a measurement. The response to the FETCh... query has the format <Status>, <Counting_No>, <Statistic_No>.

<Status> The first parameter in the response reports on the current status of the measurement. The measurement status returned is closely linked to the four measurement states described in section *Measurement Control Commands and States* on page 5.27 ff.:

OFF measurement in the *OFF* state after *RST or ABORt

RUN measurement in the *RUN* state after INITiate, CONTinue, or READ

STOP measurement in the *STOP* state after STOP (stopped explicitly)

STEP measurement in the *STEP* state due to <Stepmode> = STEP, valid measurement results

RDY measurement in the *STOP* state because stopped according to the repetition mode and stop condition set.

ERR measurement in the *OFF* state because it could not be started with INITiate or READ for lack of resources, e.g. because the RF connectors were already in use by another measurement.

<Counting_No> The second parameter in the response returns the current value of the statistics counter (the number of the current statistics cycle) if the measurement is performed in the *Counting* mode:

0 ... 10000 number of the current statistics cycle

NONE no counter for statistics cycles used, i.e. a repetition mode other than *Counting* is set.

<Statistic_No> The third parameter in the response returns the number of the current *evaluation period* (e.g. a burst length in the case of *GSM Power vs Time* or *Modulation* measurements) within a statistics cycle. For *RF Non Signalling* Measurements this counter is not used (response *NONE*).

Generator Control

The commands used for control of the CMU's RF generator are analogous to the measurement control commands explained on page 5.27. The generator is in one of the following two generator states:

OFF generator switched off, resources released

RUN generator running

The *RUN* state corresponds to the status indication *ON* in the *RF generator* softkey (see section *Analyzer/Generator Menu* in chapter 4).

The relation between generator commands and generator states is shown in the following diagram:

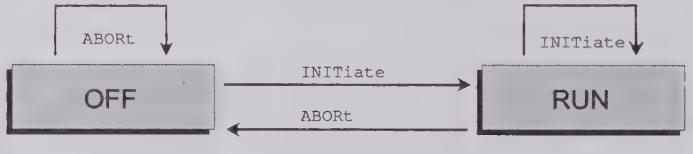


Fig. 5-8 Generator states and control commands

Generator control commands are recognized by the second-level keyword `RFGenerator`:

`INITiate:`
`RFGenerator`

Starts the generator, reserves all necessary hardware resources and changes to the generator state *RUN.*

As illustrated in Fig. 5-8, `INITiate` can be called in any generator state. If the generator is already running *(RUN),* `INITiate` has no effect.

If the generator can not be started due to a resources conflict it remains in the *OFF* state, and the measurement status returned by the `FETCh:<meas_obj>:STATus?` is *ERR.* At the same time the SCPI error –213, *Init ignored*, is generated.

Possible resources conflicts

- The RF connector is already allocated by another generator. The other generator must be switched off first.

Sequential execution

`INITiate` is implemented as a sequential command. The `*OPC` command (see chapter 6, *Common Commands)* can be applied together with the `INITiate` command.

`ABORt:`
`RFGenerator`

Switches the generator off, releases the hardware resources for other generators, and changes to the generator state *RUN.*

As illustrated in Fig. 5-8, `ABORt` can be called in any generator state. If the generator is switched off *(OFF),* `INITiate` has no effect.

Sequential execution

`ABORt` is implemented as a sequential command. The command is not terminated before the generator is completely switched off.

Generator Status

The generator status can be queried by means of the `FETCh...?` command:

FETCh command

`FETCh:<meas_obj>:STATus?`

Return the current generator status. The `FETCh...` command can be used to poll the generator status. The `FETCh...` query returns one of the following generator states:

OFF generator is in the *OFF* state (default status after `*RST` or due to `ABORt...` command).

RUN generator running (*RUN* state after `INITiate...` command).

ERR generator is in the *OFF* state because it could not be started with an `INITiate...` command for lack of resources (e.g. the RF connector is already in use by another generator).

Measurement Statistics

The *repetition mode* defines how many evaluation periods are measured if the measurement is not stopped explicitly (measurement control commands `STOP...`, `ABORt...`) in the meantime. In case of remote control the three repetition modes *Single Shot, Continuous* and *Counting* are available (*Counting* is not available in manual control, see chapter 3).

Table 5-6 Repetition mode in remote control

Repetition mode	Description	Command
Single Shot	The measurement is stopped after one evaluation period, i.e., after evaluation of the trace over the whole time/frequency range.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`SINGleshot`**`, <StopCondition>, <Stepmode>` (in RF: `<meas_obj> = POWer | SPECtrum`)
Continuous	The measurement is continued until explicitly stopped. Results are valid after one evaluation period and updated after the next evaluation period has been terminated.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`CONTinuous`**`, <StopCondition>, <Stepmode>` (in RF: `<meas_obj> = POWer | SPECtrum`)
Counting	Repeated single shot measurement with a definite number of evaluation periods. The stepping mode (<Stepmode> = STEP | NONE) determines whether the measurement is stopped after each evaluation period or not, see section *Measurement Control Commands and States* on page 5.27.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`1 ... 10000`**`, <StopCondition>, <Stepmode>` (in RF: `<meas_obj> = POWer | SPECtrum`) (A counting measurement with 1 evaluation period is equivalent to a single shot measurement.)

The statistical evaluation is more refined for the digital network tests, see the relevant operating manuals. In particular, the counting mode is extended by introduction of statistics cycles consisting of an integer number of evaluation periods.

Retrieving Measurement Results

General command structure

The results of a measurement can be retrieved by means of the `FETCh`, `SAMPle` or `READ` query. All three commands have the same structure:

```
FETCh<type>:<meas_obj>[:RESult]<spec>?
SAMPle<type>:<meas_obj>[:RESult]<spec>?
READ<type>:<meas_obj>[:RESult]<spec>?
```

The literals written in angle brackets have the following meaning:

`<type>` Measurement trace `(:ARRay)`, scalar values `([:SCALar])` can be retrieved in the network tests; see the relevant operating manuals.

To limit the number of commands and simplify the program syntax, all scalar results determined in a measurement are generally read out with a single command. They are returned as a list of values separated by commas.

The length of the arrays depends on the measurement group and possibly on the configuration settings; see also *Subarrays* paragraph below.

`<meas_obj>` Measurement group (measurement object): `POWer | SPECtrum` are used in *RF Non Signalling* mode.

`<spec>` `[:CURRent]` current evaluation period, other statistical traces can be retrieved in the network tests.

Subarrays

Arrays generally consist of a large number of values representing the measurement trace over the whole time or frequency range. With the `SUBarrays` commands, the CMU provides a flexible tool for handling large amounts of data. These commands restrict a measurement to up to 32 subranges where either all measurement results or a single statistical value can be read out.

Subarray configuration

The subarrays are configured with the following commands:

```
CONFigure:SUBarrays:<meas_obj> <Mode>, <Start>, <Samples>
                                    {,<Start>, <Samples>}
```

`<meas_obj>` Measurement group (measurement object). For examples refer to the manuals for the network tests.

`<Mode>` Statistics mode for **all** subranges. The following parameters can be set:

- `ALL` Return all measurement values (the number of values in every subrange is given by the `<Samples>` parameter)
- `ARIThmetical` Return the arithmetical mean value of the results in every subrange
- `MINimum` Return the minimum of the results in every subrange
- `MAXimum` Return the maximum of the results in every subrange

`<Start>` Start of current range (time or frequency or channel number).

`<Start>` Number of samples in current range.

The subranges may overlap but must be within the total range of the `<meas_obj>`. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Subarray results

Subarray results are retrieved by means of `FETCh, SAMPle` or `READ` queries, with `:SUBarrays` inserted as a second-level keyword:

```
FETCh:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
SAMPle:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
READ:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
```

In the default subarray configuration, these commands are identical with the `FETCh, SAMPle` or `READ` queries described above (i.e. all measurement results are read out).

FETCh command FETCh<type>:<meas_obj>[:RESult]<spec>?

Retrieves the latest valid measurement results.

If the FETCh query is used immediately after an INITialize... command, the first evaluation period is terminated before the query is executed so that a valid result can be acquired. If called up repeatedly after termination of the first evaluation period, the FETCh query may return the same results several times until they have been updated after the next period.

A FETCh returns the results without interaction with the measurement (unsynchronized query). In some cases this may cause inconsistent results to be read so that the SAMPle command should be used while the measurement is in the *RUN* state.

Measurement states According to the definition given above the effect of the FETCh query depends on the measurement status and the history of the measurement:

Status	Valid Results?	Effect of FETCh...?
≠ OFF	Yes	Returns the current results.
OFF	No	Generates an SCPI error –230, *Data corrupt or stale*. This is why FETCh should not be used while the measurement is in the *OFF* state.
RUN	No	Waits until valid results are available and returns these results.
STOP	No	Generates an SCPI error –230, *Data corrupt or stale*. This scenario occurs, e.g. if the measurement is stopped explicitly before the first evaluation period has been terminated.

SAMPle command SAMPle<type>:<meas_obj>[:RESult]<spec>?

Retrieves the results of the current evaluation period. In single shot measurements, SAMPle is equivalent to READ.

In a *continuous* measurement, or in *counting* mode (see *repetition mode* in Table 5-6), SAMPle is executed only after termination of the current evaluation period. This implies that a single measurement result can be returned only once by a SAMPle query; if called up repeatedly, SAMPle will return the result of subsequent evaluation periods.

Due to this behavior, the SAMPle query is suitable for monitoring the progress of *continuous* measurements in time. Multiple identical results, which might be returned by repeated FETCh commands, are avoided.

A SAMPle query returns the results after interacting with the measurement (synchronized query). This means that only valid results are returned, inconsistencies are avoided.

Measurement states According to the definition given above the effect of the SAMPle query depends on the measurement status and the history of the measurement:

Status	Valid Results?	Effect of SAMPle...?
STOP | RDY | STEP	Yes	Returns the current results. In this case, the SAMPle command is equivalent to the FETCh command.
OFF	No	Generates an SCPI error –230, *Data corrupt or stale*. This is why SAMPle should not be used while the measurement is in the *OFF* state.
RUN	Yes | No	Waits until the end of the current evaluation period, returns the results, and resumes the measurement (unless the current evaluation period is the last to be measured).
STOP	No	Generates an SCPI error –230, *Data corrupt or stale*. This scenario occurs, e.g. if the measurement is stopped explicitly before the first evaluation period has been terminated.

READ command

`READ<type>:<meas_obj>[:RESult]<spec>?`

Starts a new measurement, terminates the measurement and returns the results after one single shot. The `READ...?` query is equivalent to:

```
ABORt...;
INITiate...;
FETCh...?
```

The `READ` command preserves all configurations (such as event reporting, stop condition, statistics count...). `READ` initiates a measurement which is terminated after one single shot (measurement state *STOP*, status *RDY*; if an error occurred, the status is *ERR*). However, it does not affect the repetition mode setting itself.

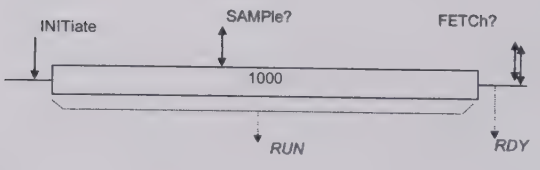
In case of no error (status *RDY*), the measurement can be continued by means of the `CONTinue` command. It will be performed with the repetition mode set before `READ` was executed.

Diagrammatic Overview of Measurement Control

As pointed out in the previous sections the commands used to configure and control the measurements, to query the status of the measurement, and to retrieve the measurement results are closely linked to the settings for the repetition mode and stop condition. The various scenarios are most easily explained by means of a graphical representation of the measurements.

Single Shot Measurements

Stop condition: NONE



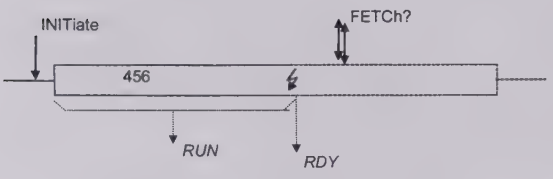
A single shot measurement comprising 1000 evaluation periods with stop condition none is performed. The measurement is started with the `INITiate` command. The results can be queried using the `SAMPle...?` (status *RUN* or *RDY)* or `FETCh...?` (status *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,1000
CONFigure:<meas_obj>:CONTrol:REPetition
```

```
SINGleshot,NONE,<Stepmode>
```

The <Stepmode> parameter has no effect.

Stop condition: SONerror



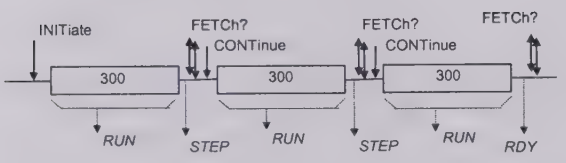
A single shot measurement comprising 1000 evaluation periods with stop condition SONerror is performed. The measurement is started with the `INITiate` command and stopped before the end of the statistics cycle. The results can be queried using the `SAMPle...?` (status *RUN* or *STOP)* or `FETCh` (status *STOP)* commands. The number of bursts measured can be queried using the `FETCh:<meas_obj>:STATus?` command. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,1000
CONFigure:<meas_obj>:CONTrol:REPetition
                    SINGleshot,SONerror
                    <Stepmode>
```

The <Stepmode> parameter has no effect.

Counting Measurements

Stop condition: NONE

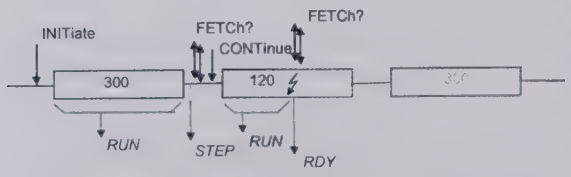


A counting measurement comprising 3 counts of measurements, each about a statistics cycle of 300 evaluation periods, is performed. The measurement is started with the `INITiate` command. The results can be queried using the `SAMPle...?` (status *RUN, STEP* or *RDY)* or `FETCh...?` (status *STEP* or *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,300
CONFigure:<meas_obj>:CONTrol:REPetition
                    3,NONE,<Stepmode>
```

The STEP status occurs only if the stepping mode is set (`<Stepmode> = STEP`). In this case, the next cycle must be restarted via the `CONTinue` command.

Stop condition: SONerror



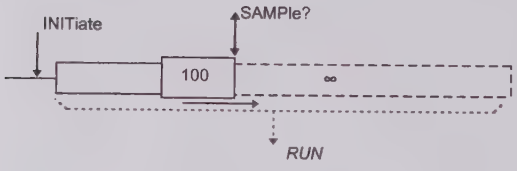
A counting measurement comprising counts of measurements, each about a statistics cycle of 300 evaluation periods, is performed. The measurement is started with the `INITiate` command. The results can be queried using the `SAMPle...?` (status *RUN, STEP* or *RDY)* or `FETCh...?` (status *STEP* or *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,300
CONFigure:<meas_obj>:CONTrol:REPetition
                    3,SONerror,<Stepmode>
```

The STEP status occurs only if the stepping mode is set (`<Stepmode> = STEP`). In this case, the next cycle must be restarted via the `CONTinue` command.

Continuous Measurements

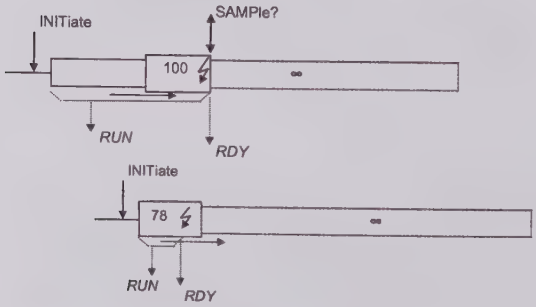
Statistics cycles, stop condition: NONE



A continuous measurement with statistics cycles consisting of 100 bursts each is performed. The window used for evaluating average values is continuously shifted, comprising the latest 100 evaluation periods. The measurement is started with the `INITiate` command. Results can be queried using the `SAMPle...?` command (status *RUN)*. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> 100
CONFigure:<meas_obj>:CONTrol:REPetition
                    CONTinuous,NONE,NONE
```

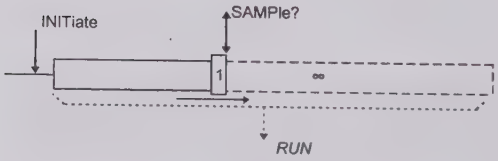
Statistics cycles, stop condition: SONerror



A continuous measurement with statistics cycles consisting of 100 evaluation periods each is performed. The measurement is started with the `INITiate` command. Results can be queried the `SAMPle...?` command (status *RUN, STOP)*. During the measurement `FETCh...?` may return inconsistent results. If the stop condition is met during the first statistics cycle no valid result is available. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> 100
CONFigure:<meas_obj>:CONTrol:REPetition
                    CONTinuous,SONerror,NONE
```

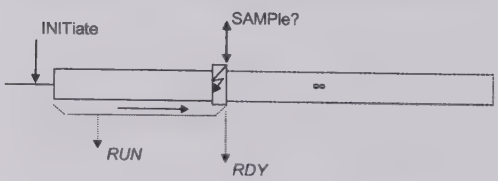
Statistics off, stop condition: NONE



A continuous measurement is performed. No statistics cycles are defined. The measurement is started with the `INITiate` command. Results can be queried using the `SAMPle...?` command (status *RUN)*. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> OFF
CONFigure:<meas_obj>:CONTrol:REPetition
                    CONTinuous,NONE,NONE
```

Statistics off, stop condition: SONerror



A continuous measurement is performed. No statistics cycles are defined. The measurement is started with the `INITiate` command. Results can be queried the `SAMPle...?` command (status *RUN, STOP)*. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> OFF
CONFigure:<meas_obj>:CONTrol:REPetition
                    CONTinuous,SONerror,NONE
```

Note: *The* stepping *mode can be set for continuous measurements as well (Parameter* `<Step-mode>=STEP`*, see section* Counting Measurements *on page 5.37). In this case, the system takes up the STEP status after each statistics cycle. It can be relaunched via the* `CONTinue` *command.*

Special Terms and Notation

Below we list some particular features in the syntax of the remote control commands. The general description of the SCPI command syntax can be found in section *Structure and Syntax of Device Messages* on page 5.6.

Description of commands

The commands are arranged in tables; all of them are arranged in the same way. From top to bottom, the table rows contain the following entries:

1. Complete command syntax including the parameter list and a short description of the command,
2. List and description of the parameters with their default values, the units, and unit rings.
3. Detailed description of the command, signalling state required for command execution, required firmware version.

Extensive lists of default values are annexed to the command description.

Order of commands

The commands are arranged according to their function. The general purpose of a command is described by the keyword in the second level. Lower-level keywords define the command in more detail. This means that commands with the same second-level, third-level etc. keywords are generally grouped together in the same sections.

Example:
```
CONFigure:POWer:MARKer:REFerence:POSition
                              <Position>
```

Commands with the keyword *POWer* in the second level belong to the power measurement. The keywords in the third, fourth and fifth level indicate that the command defines the position of the reference marker used in the power measurement.

Measurement object

The term *measurement object* denotes a group of remote control commands relating to the same group of measured quantities. E.g., all commands concerning the measurement of the signal power vs time form a common measurement object.

Combined measurements

To limit the number of remote control command and their parameters, scalar quantities of the same measurement object are always measured together and returned in lists.

Parameters

Many commands are supplemented by a parameter or a list of parameters. Parameters either provide alternative options (setting a or setting b or setting c ..., see special character "|"), or they form a list separated by commas (setting x,y).

<Par_Name>

In the command tables and lists, parameters are generally described by a name (literal) written in angle brackets (<>). This literal merely serves as a parameters description; in an application program it must be replaced by one of the possible settings reported in the detailed parameter description.

Example:
```
CONFigure:POWer:CONTrol <Mode>,<Statistics>
```
with
```
<Mode>       = SCALar | ARRay
<Statistics> = 1 to 10000 | NONE
```
possible command syntax:
```
CONF:POW:CONT SCAL,OFF
```

NAN NAN (not a number) is generally used to represent missing data, e.g. if a portion of a trace has not been acquired yet. It is also returned after invalid mathematical operations such as division by zero. As defined in the SCPI standard, NAN is represented as 9.91 E 37.

INV INV (invalid) is returned if a limit check is performed without defining the appropriate tolerance values.

Upper / lower case Upper/lower case characters characterize the long and short form of the keywords in a command. The short form consists of all upper-case characters, the long form of all upper case plus all lower case characters. On the CMU, either the short form or the long form are allowed; mixed forms will generally not be recognized. Either the short form or the long form are permissible. The instrument itself does not distinguish upper case and lower case characters.

Special characters

| A vertical stroke in the parameter list characterizes alternative parameter settings. Only one of the parameters separated by | must be selected.

Example: The following command has two alternative settings:

```
TRIGger:SEQuence:DEFault ON | OFF
```

[ ] *Key words* in square brackets can be omitted when composing the command header (see chapter 5 of the CMU manual, section "Structure of a Command"). The complete command must be recognized by the instrument for reasons of compatibility with the SCPI standard.
Parameters in square brackets are optional as well. They may be entered in the command or omitted.

{ } Braces or curly brackets enclose one or more parameters that may be included zero or more times.

<nr> This symbol stands for a numeric suffix, e.g. an enumeration index for input and output connectors.

Lists of commands

Command: The *Command* column of the table contains all remote control commands arranged according to their function (configurations or measurement objects). Within a section, the commands are listed in alphabetical order.

Parameters: The *Parameter* column lists the parameters of the commands.

Remarks: The *Remarks* column gives additional information about the commands which

- Have no query form *(no query)*
- Have only a query form *(query only)*
- Can be used both as setting commands and as queries (*with query*, this applies to all commands belonging to none of the two preceding categories)

Alphabetical Lists Chapter 6 concludes with alphabetical command lists for both test modes.

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6 Remote Control – Commands

In the following, all remote-control commands for the *Base* system and the function groups *RF Non Signalling* and *Audio* will be presented in tabular form with their parameters and the ranges of numerical values. The chapter is organized as follows:

- Common commands, commands for the base system and the function groups *RF Non Signalling* and *Audio* are presented separately.
- Within the measurement modes, first the general configuration and then the individual measurement groups (measurement objects) are dealt with.

An introduction to remote control according to the SCPI standard, the status registers of the CMU, and the operating concept and measurement control is given in chapter 5.

Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in chapter 5.

Table 6-1 Common Commands

Command	Parameters	Remark
*CLS		no query
*ESE	0 to 255	
*ESR?		query only
*IDN?		query only
*IST?		query only
*OPC		
*OPT?		query only
*PRE	0 to 255	
*PSC	0 | 1	
*RST		no query
*SEC	0 to 30	No common command; see p. 6.12
*SRE	0 to 255	
*STB?		query only
*TST?		query only
*WAI		

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE** 0 to 255

EVENT STATUS ENABLE sets the event status enable register to the value indicated. Query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST-flag is the status bit which is sent during a parallel poll (see chapter 5).

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. chapter 5).

***OPC?**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. chapter 5).

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas and have fixed positions in the output string. A zero is returned for options that are not installed.

Example: `B11/B12,0,B52,B61,0,K21,...`

An alternative list of options can be queried via the command SYSTem:OPTions?

***PRE 0 to 255**

PARALLEL POLL REGISTER ENABLE sets parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC 0 | 1**

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset in switching on.

*PSC = 0 causes the contents of the status registers to be maintained. Thus a service request can be triggered in switching on in the case of a corresponding configuration of status registers ESE and SRE.

*PSC ≠ 0 resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the [RESET] key. The default setting is indicated in the description of commands.

***SRE 0 to 255**

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. Query *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads the contents of the status byte in decimal form.

***TST?**

SELF TEST QUERY triggers selftests of the instrument and outputs an error code in decimal form (the output is zero in the current firmware version).

***WAI**

WAIT-to-CONTINUE only permits the servicing of the subsequent commands after all preceding commands have been executed and all signals have settled (see also chapter 5 and "*OPC").

CMU Base System

System Commands

The SYSTem subsystem collects the functions that are not related to instrument performance. The CMU supports the following SCPI-confirmed SYSTem commands:

SYSTem:ERRor?				Error queue
Response	Parameter description	Def. value	Default unit	Unit ring
-32768 to +32768 and error string **Ex.: -230,"Data corrupt or stale"**	Error message	0	–	
Command description				FW vers.
This command queries the next entry from the error/event queue and deletes it. Positive error numbers are instrument-dependent; negative error numbers are reserved by the SCPI standard, see chapter 9. If the error queue is empty, the error number 0, "No error" is returned.				≥ V 1.20

SYSTem:VERSion?				SCPI version
Response	Parameter description	Def. value	Default unit	Unit ring
YYYY.V **Ex.: 1990.0**	SCPI version of CMU	–	–	
Command description				FW vers.
This command queries the SCPI version number for which the instrument complies. YYYY is the year of SCPI compliance, V is the version number within the year.				≥ V 1.20

Status Commands

The STATus subsystem controls the SCPI-defined status reporting structures. The purpose and definition of status registers is given in chapter 5, section "Status Reporting System". Unless otherwise stated, all the following commands are SCPI-confirmed.

STATus:OPERation[:EVENt]?				Event part
Response	Parameter description	Def. value[1]	Default unit	Unit ring
0 to 32767	Event part	–	–	
Command description				FW vers.
This command queries and deletes the contents of the EVENt part of the STATus:OPERation register.				≥ V 1.20

[1] *RST does not supersede the entries in the status registers; for an overview of the reset values of the STATus... system refer to section *Reset Values of the Status Reporting Systems* in chapter 5.

STATus:OPERation:CONDition?				CONDition part
Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Condition part	–	–	
Command description				FW vers.
This command queries the contents of the CONDition part of the STATus:OPERation register. Reading this register is nondestructive.				≥ V 1.20

STATus:OPERation:PTRansition *<Number>*				Positive transition
<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Positive transition part	–	–	
Command description				FW vers.
This command enters a number to be interpreted as a bit pattern in the PTRansition part of the STATus:OPERation register. If a bit is set the corresponding 0-to-1 transition in the CONDition part (indicating that an event in the hardware occurred) is entered into the EVENt part.				≥ V 1.20

STATus:OPERation:NTRansition *<Number>*				Negative transition
<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Negative transition part	–	–	
Command description				FW vers.
This command enters a number to be interpreted as a bit pattern in the NTRansition part of the STATus:OPERation register. If a bit is set the corresponding 1-to-0 transition in the CONDition part (indicating that an event in the hardware disappeared) is entered into the EVENt part.				≥ V 1.20

STATus:OPERation:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Enable part	–	–	
Command description				FW vers.
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation register. If a bit is set the corresponding event is reported in the summary bit of the status byte.				≥ V 1.20

STATus:OPERation:CMU:SUM<nr>[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Event part	–	–	
Command description				FW vers.
This command queries and deletes the contents of the EVENt part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2).				≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:CONDition? — CONDition part

Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Condition part	–	–	

Command description — FW vers.

This command queries the contents of the CONDition part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2). Reading this register is nondestructive. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:PTRansition *<Number>* — Positive transition

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Positive transition part	–	–	

Command description — FW vers.

This command enters a number to be interpreted as a bit pattern in the PTRansition part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2). If a bit is set the corresponding 0-to-1 transition in the CONDition part (indicating that an event in the hardware occurred) is entered into the EVENt part. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:NTRansition *<Number>* — Negative transition

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Negative transition part	–	–	

Command description — FW vers.

This command enters a number to be interpreted as a bit pattern in the NTRansition part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2). If a bit is set the corresponding 1-to-0 transition in the CONDition part (indicating that an event in the hardware disappeared) is entered into the EVENt part. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:ENABle *<Number>* — Enable part

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Enable part	–	–	

Command description — FW vers.

This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation:CMU:SUM<nr> register (<nr> = 1,2). If a bit is set the corresponding event is reported in the summary bit of the status byte. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[:EVENt]? — Event part

Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Event part	–	–	–

Command description — FW vers.

This command queries and deletes the contents of the EVENt part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15). — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:CONDition? CONDition part

Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Condition part	–	–	

Command description — FW vers.

This command queries the contents of the CONDition part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15). Reading this register is nondestructive. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:PTRansition <*Number*> Positive transition

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Positive transition part	–	–	

Command description — FW vers.

This command enters a number to be interpreted as a bit pattern in the PTRansition part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15). If a bit is set the corresponding 0-to-1 transition in the CONDition part (indicating that an event in the hardware occurred) is entered into the EVENt part. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:NTRansition <*Number*> Negative transition

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Negative transition part	–	–	

Command description — FW vers.

This command enters a number to be interpreted as a bit pattern in the NTRansition part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15). If a bit is set the corresponding 1-to-0 transition in the CONDition part (indicating that an event in the hardware disappeared) is entered into the EVENt part. — ≥ V 1.20

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle <*Number*> Enable part

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Enable part	–	–	

Command description — FW vers.

This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> register (<nr> = 1 to 2; <nr_event> = 1 to 15). If a bit is set the corresponding event is reported in the summary bit of the status byte. — ≥ V 1.20

STATus:OPERation:CMU:ALL? Query all operation registers

Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767, ... , 0 to 32767	Event part of all CMU operation registers	–	–	

Command description — FW vers.

This command queries the EVENt parts of all STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> registers. The result is returned as a list of 30 integer values separated by commas. — ≥ V 1.20

STATus:OPERation:CMU:CLEar — Clear all operation registers

Command description	FW vers.
This command clears the EVENt parts of all STATus:OPERation:CMU:SUM<nr>:CMU<nr_event> registers (<nr> = 1 to 2; <nr_event> = 1 to 15).	≥ V 1.20

STATus:QUEStionable[:EVENt]? — Event part

Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Event part	–	–	

Command description	FW vers.
This command queries and deletes the contents of the EVENt part of the STATus:QUEStionable register.	≥ V 1.20

STATus:QUEStionable:CONDition? — CONDition part

Response	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Condition part	–	–	

Command description	FW vers.
This command queries the contents of the CONDition part of the STATus:QUEStionable register. Reading this register is nondestructive.	≥ V 1.20

STATus:QUEStionable:PTRansition <*Number*> — Positive transition

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Positive transition part	–	–	

Command description	FW vers.
This command enters a number to be interpreted as a bit pattern in the PTRansition part of the STATus:QUEStionable register. If a bit is set the corresponding 0-to-1 transition in the CONDition part (indicating that an event in the hardware occurred) is entered into the EVENt part.	≥ V 1.20

STATus:QUEStionable:NTRansition <*Number*> — Negative transition

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Negative transition part	–	–	

Command description	FW vers.
This command enters a number to be interpreted as a bit pattern in the NTRansition part of the STATus:QUEStionable register. If a bit is set the corresponding 1-to-0 transition in the CONDition part (indicating that an event in the hardware disappeared) is entered into the EVENt part.	≥ V 1.20

STATus:QUEStionable:ENABle <*Number*> — Enable part

<Number>	Parameter description	Def. value	Default unit	Unit ring
0 to 32767	Enable part	–	–	

Command description	FW vers.
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:QUEStionable register. If a bit is set the corresponding event is reported in the summary bit of the status byte.	≥ V 1.20

STATus:PRESet	Reset status registers
Command description	FW vers.
This command sets the edge detectors (PTRansition and NTRansition parts) and the ENABle registers of the STATus:OPERation and the STATus:QUEStionable registers to defined values: • PTRansition is set to 32767 (0x7FFF), i.e. all hardware events are detected and transferred to the EVENt register. • NTRansition is set to 0, i.e. a hardware event that disappears does not cause any change in the EVENt register. The ENABle registers are also set to 0 so that events are not reported in the status byte.	≥ V 1.20

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported and the corresponding function groups; see section *Symbolic Status Event Register Evaluation* in chapter 5.

STATus:OPERation:EVENt:SADDress?

Response	Parameter description	Def. Value[2]	Default Unit	Unit Ring
1 to 30, **"Fgrp"**	"Next" secondary address Corresponding function group name (or "", if no event was reported)	31 ""	– –	

Command description	FW vers.
This command is always a query. It checks the `STATus:OPERation:CMU:SUM<nr>:EVENt` sum registers (<nr> = 1 | 2), returns the next secondary address and function group string where an event was reported, and deletes the entry in the `EVENt` register. If applied repeatedly, the command checks the secondary addresses in ascending order (i.e. the events are not queried chronologically). The command is global; it is available in all function groups. Possible responses are: *1,"RF_NSig"* An event was reported in function group *RF Non Signalling* (currently assigned to secondary address 1). *31,""* No (further) event reported.	≥ V2.10

[2] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>}

Parameter list	Parameter description	Def. Value[3]	Default Unit	Unit Ring
<Event>{,<Event>} | NONE	List of symbols for events to be reported No event reported	NONE	–	

Command description	FW vers.
This command enables event reporting for one or several events in the current function group, ie. it sets the corresponding bits in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle` register (`<nr> = 1 | 2, <nr_event>` denotes the current function group) and in all sum registers up to the status byte. The events and the corresponding symbols for each function group are listed in chapter 5 of the relevant manuals (see section *STATus:OPERation Register).* The symbols may be entered in arbitrary order.	≥ V2.10

STATus:OPERation:SYMBolic[:EVENt]?

Response	Parameter description	Def. Value[4]	Default Unit	Unit Ring
NONE | <Event>{,<Event>}	No event in the current function group List of reported events	NONE	–	

Command description	FW vers.
This command is always a query. It lists the events reported in the current function groups and deletes these events in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:EVENt` register as well as in all sum registers.	≥ V2.10

[3] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

[4] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

Setup – Basic Device Settings

The SETup subsystem contains the commands for global configuration of the remote control parameters, the serial interfaces, the options, date and time, the keyboard and beeper. It corresponds to the *Setup* menu opened via the *SETUP* key on the front panel.

Subsystem Remote

The *REMote* subsystem contains the commands for configuration of the remote control parameters. It corresponds to the *Remote* index card in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:REMote:ADDRess:PRIMary <*Addr*> — Primary address

<*Addr*>	Parameter description	Def. value	Default unit	Unit ring
0 to 30	Primary address to the GPIB (IEEE) bus	20	–	

Command description — FW vers.

This command sets the primary address of the GPIB driver which is used to address the device (CMU). It is equivalent to `SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` (see below). — ≥ V 1.20

SYSTem:REMote:ADDRess:SECondary <*Addr*>,<*FGrp*>|*NONE* — Secondary address

<*Addr*>,<*FGrp*>	Parameter description	Def. value	Default unit	Unit ring
1 to 30, „FGrp_name" | NONe	Secondary address of the GPIB bus Name of the function group or NONE if the secondary address is not to be mapped	Dll-specific	–	

Command description — FW vers.

This command assigns the secondary addresses to the remote control modes (function groups) of the GPIB driver (compare next command). If a secondary address is successively assigned to different function groups the previous assignments are overwritten. The following function group names are defined: — ≥ V 1.17

FGrp_name	Function Group
BASE	CMU base system
RF_NSig	RF Non Signalling
GSM900MS_NSig	GSM900-MS Non Signalling
GSM900MS_Sig	GSM900-MS Signalling
GSM1800MS_NSig	GSM1800-MS Non Signalling
GSM18900MS_Sig	GSM1800-MS Signalling
GSM1900MS_NSig	GSM1900-MS Non Signalling
GSM1900MS_Sig	GSM1900-MS Signalling

The CMU base system (function group *BASE)* is always assigned to secondary address 0; the assignment cannot be changed by the `SYSTem:REMote:ADDRess:SECondary` command. A program example illustrating how to adapt the secondary addresses to the requirements of a specific driver can be found in chapter 7.

Example:

```
Setting:        SYST:REM:ADDR:SEC 2,"GSM900MS_NSig"
                SYST:REM:ADDR:SEC 1,NONE
Query:          SYST:REM:ADDR:SEC? 2
--> Response:   "GSM900MS_NSig"
Query:          SYST:REM:ADDR:SEC? 1
--> Response:   NONE
Query:          SYST:REM:ADDR:SEC?
--> Response:   NONE,"GSM900MS_NSig", ...  (30 returned values)
```

***SEC <Addr>**				Secondary address
<Addr>	Parameter description	Def. value	Default unit	Unit ring
0 to 30	Secondary address	0	–	
Command description				FW vers.
This command has no query form. It switches over to the specified secondary address. It is required if the serial interface is used for remote control (software switchover, RS-232 remote interface, see previous command and section *Setting the Device Address* in chapter 5).				≥ V 1.20

Subsystem Communicate

The *COMMunicate* subsystem contains the commands for configuration of the remote serial interfaces. It corresponds to the *Communicate* index card in the *Setup* menu opened via the *SETUP* key on the front panel. The parameters set in this subsystem are explained in more detail in chapter 8, section *Hardware Interfaces*.

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Addr>				Primary address
<Addr>	Parameter description	Def. value	Default unit	Unit ring
0 to 30	Primary address to the GPIB (IEEE) bus	20	–	
Command description				FW vers.
This command sets the primary address of the GPIB driver which is used to address the device (CMU). It is equivalent to `SYSTem:REMote:ADDRess:PRIMary` (see above).				≥ V 1.20

SYSTem:COMMunicate:SERial<1|2>:APPLication?				Application
Response	Parameter description	Def. value	Default unit	Unit ring
TRAN | **REM |** **PRIN**	Transfer Remote control Printer control (future extension)	dep. on SCPI connection (port) and printer settings	-	
Command description				FW vers.
This command is always a query. It returns the current application (connection) of the serial (RS-232) interface. The numeric suffix distinguishes the two interfaces COM1 and COM2.				≥ V 1.20

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD <Baudrate>				Baud rate
<Baudrate>	Parameter description	Def. value	Default unit	Unit ring
110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200	baud rate	19200	–	
Command description				FW vers.
This command sets the baud rate of the serial interface no. 1 or 2 (connectors COM 1 or COM 2).				≥ V 1.20

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITs <*DataBits*>				Data bits
<DataBits>	Parameter description	Def. value	Default unit	Unit ring
7 | 8	number of data bits	8	–	
Command description				FW vers.
This command sets the number of data bits of the serial interface no. 1 or 2 (connectors COM 1 or COM 2). The sum of data bits and stop bits must be equal to 9.				≥ V 1.20

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:STOP <*StopBits*>				Stop bits
<StopBits>	Parameter description	Def. value	Default unit	Unit ring
1 | 2	number of stop bits	1	-	
Command description				FW vers.
This command sets the number of stop bits of the serial interface no. 1 or 2 (connectors COM 1 or COM 2). The sum of data bits and stop bits must be equal to 9.				≥ V 1.20

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARity[:TYPE] <*Parity*>				Parity
<Parity>	Parameter description	Def. value	Default unit	Unit ring
NONE **ODD** **EVEN**	no parity odd parity even parity	NONE	–	
Command description				FW vers.
This command sets the parity of the serial interface no. 1 or 2 (connectors COM 1 or COM 2).				≥ V 1.20

SYSTem:COMMunicate:SERial<1|2>:TRANsmit:PACE <*Pace*>				Transmission protocol
<Pace>	Parameter description	Def. value	Default unit	Unit ring
XON **ACK** **NONE**	Xon/Xoff – protocol Hardware protocol with CTS/RTS lines No protocol set	ACK	–	
Command description				FW vers.
This command sets the handshake protocol of the serial interface no. 1 or 2 (connectors COM 1 or COM 2).				≥ V 1.20

Subsystem Options

The *Options* subsystem contains the commands for querying information on the instrument and the available options. It corresponds to the *Options* index card in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:OPTions:INFo?			Device information
Response	Def. value	Default unit	Unit ring
Example: ROHDE&SCHWARZ,CMU200,840675/018,V1.17B 1998-11-30	–	–	
Command description			FW vers.
This command returns the information on the device comprising the manufacturer, model, serial number and firmware version. This command is always a query and is equivalent to the common command `*IDN?`			≥ V 1.20

SYSTem:OPTions? or ***OPT?** — Options

Response	Parameter description	Def. value	Default unit	Unit ring
HWO, **"B11/B12","01.00",** **"B2",NAN, ... ,**	Identifier for hardware options 1st option, 2nd option, 3, 4 ...	–	–	
SWO, **"K1","1.07",** **"K2",NAN, ... ,**	Identifier for software options 1st Option, 2nd Option, 3, 4 ...			
HWE, **"CPU(FMR)", "01"** **...**	Identifier for hardware equipment 1st equipment, 2nd equipment, 3, 4 ...			
FWV, **„uP1","01.00",** **...**	Identifier for firmware versions 1st Option, 2nd Option, 3, 4 ...			
	NAN (not a number) denotes „not installed" or „disabled"			

Command description — FW vers.

This command returns a list of all options and equipment available in the instrument. It is always a query. — ≥ V 1.20

An alternative list of options (following IEEE 488.2 conventions) can be queried via the common command *OPT?

Subsys Time

The *Time* subsystem contains the commands for the current time and date. It corresponds to the *Time* index card in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:TZONe ***<Hour>[,<Minute>]*** or
SYSTem:TIMe:TZONe ***<Hour>[,<Minute>]*** — Time zone

Parameters	Parameter description	Def. value	Default unit	Unit ring
<Hour>	integer value between –12 and +12	+1	–	
<Minute>	-59 to +59 (optional)			

Command description — FW vers.

This command defines the time zone via the time offset from Greenwich mean time. A time offset of +1 h (default setting) corresponds to Middle European time. — ≥ V 1.20

SYSTem:TIMe[:TIMe] ***<Hour>,<Minute>,<Second>*** or
SYSTem:TIMe ***<Hour>,<Minute>,<Second>*** — Current time

Parameters	Parameter description	Def. value	Default unit	Unit ring
<Hour>,	Hours (0 to 23)	–	h	
<Minute>,	Minutes (0 to 59)	–	min	
<Second>	Seconds (0 to 59)	–	s	

Command description — FW vers.

This command sets the internal system time of the CMU. — ≥ V 1.20

SYSTem:TIMe:DATe <*Year*>,<*Month*>,<*Day*> or
SYSTem:DATE <*Year*>,<*Month*>,<*Day*> — Date

Parameters	Parameter description	Def. value	Default unit	Unit ring
<Year>,	Four-digit year (1980 to 2099)	–	–	
<Month>,	Month (1 to 12)	–		
<Day>	Day (1 to 31)	–		

Command description	FW vers.
This command sets the internal system date of the CMU.	≥ V 1.20

Subsys MISCellaneous

The *Miscellaneous* subsystem contains the commands for setting the acoustic signal and selecting the external keyboard assignment. It corresponds to the *Misc.* index card in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:MISCellaneous:KBEep <*Enable*> — Beeper

<Enable>	Parameter description	Def. value	Default unit	Unit ring
ON |	Key beep on	OFF	–	
OFF	Key beep off			

Command description	FW vers.
This command switches the acoustic signal of the CMU on or off.	≥ V 1.20

SYSTem:MISCellaneous:KEYBoard <*Country*> — Keyboard assignment

<Country>	Parameter description	Def. value	Default unit	Unit ring
US |	American keyboard	US	–	
GR	German keyboard			

Command description	FW vers.
This command selects the driver for the external keyboard.	≥ V 1.20

Subsys MQUeue

The *MQUeue* subsystem contains the commands for symbolic measurement ready evaluation. These commands are used to query the contents of the measurement queue. To activate the measurement queue, event reporting must not be switched off; see section *Event Reporting* in chapter 5.

SYSTem:MQUeue[:COMPlete][:LIST]?				Complete measurement queue
Response	Parameter description	Def. value	Default unit	Unit ring
<FGroup_Mode>, <MeasObject>, ...	Function group and test mode Ready measurement	"NONE", "NONE"	–	
Command description				FW vers.
This command is always a query. It returns and deletes the contents of the complete measurement queue. The individual results are returned in chronological order (first in first out). Examples of possible responses are: "RF_NSig","POWer","RF_NSig","SPECtrum" Power and spectrum mesurement ready in function group *RF*, test mode *Non Signalling* "NONE", "NONE" No ready measurements reported				≥ V2.10

SYSTem:MQUeue[:COMPlete]:ITEM?				Next entry in measurement queue
Response	Parameter description	Def. value	Default unit	Unit ring
<FGroup_Mode>, <MeasObject>	Function group and test mode Ready measurement	"NONE", "NONE"	–	
Command description				FW vers.
This command is always a query. It returns and deletes the oldest ready measurement in the measurement queue.				≥ V2.10

Reset

The *Preset* subsystem contains the commands for resetting the default values. It corresponds to the *Reset* menu opened via the *RESET* key on the front panel.

SYSTem:PRESet[:ALL]	Reset values
Command description	FW vers.
This command sets all parameters of the instrument to their default values.	≥ V 1.20

Synchronization

The *Synchronize* subsystem contains the commands for configuring the reference frequency. It corresponds to the *Reference Frequency* softkey in the *Sync.* index card of the *Connection Control* menu.

CONFigure:SYNChronize:FREQuency:REFerence <*Frequency*>				Reference frequency
<Frequency>	Parameter description	Def. value	Default unit	Unit ring
10 kHz to 52 MHz	Reference frequency	10 MHz	Hz	
Command description				FW vers.
The command defines the frequency of the synchronization signal.				≥ V 1.12

CONFigure:SYNChronize:FREQuency:REFerence:MODE <*Mode*>				Source of ref. frequency
<Mode>	Parameter description	Def. value	Default unit	Unit ring
INTernal | EXTernal	internal reference frequency used external reference frequency used	INT	–	
Command description				FW vers.
The command defines the source of the synchronization signal.				≥ V 1.12

RF Measurements

Group Configuration

The remote-control commands presented in this section configure the measurements in the function group *RF Non Signalling* globally, i.e. for all subsequent measurements. They correspond to the settings in the popup menu of the *Group Config.* softkey located to the left of the header of each main menu (see chapter 3).

Subsystem LEVel (Input Level)

The subsystem *LEVel* contains the commands for determination and/or modification of the input level for the currently used input. It corresponds to the index card *Input Level* in the popup menu *Group Configuration* and the *Input Level – Reference* hotkey in the *Spectrum* menu.

[SENSe:]LEVel:MAXimum <*Level*> — Maximum input level for power vs. time

<*Level*>	Parameter description	Def. value	Default unit	Unit ring
0 dBm to +47 dBm	Max. input level for RF 1	0.0	dBm	
–14 dBm to 33 dBm	Max. input level for RF 2	0.0		
–37 dBm to 0 dBm	Max. input level for RF 4 IN	0.0		

Command description	FW vers.
This command defines the expected maximum input level for *Power vs Time* measurements and sets the input measurement path accordingly. The value range depends on the used RF input and the external attenuation.	≥ V 1.15

[SENSe:]LEVel:ATTenuation <*Mode*> — Attenuation of input measurement path

<*Mode*>	Parameter description	Def. value	Default unit	Unit ring
NORMal | LNOise | LDIStortion	Normal Low noise (level at mixer 10 dB higher than in normal setting) Low distortion factor (level at mixer 10 dB lower than in normal setting)	NORMal	–	

Command description	FW vers.
This command defines the attenuation or gain of the input measurement path.	≥ V 1.15

[SENSe:]LEVel:MODE <*Mode*> — Input level – setting

<*Mode*>	Description of parameters	Def. value	Def. unit	Unit ring
MANual | AUTomatic	Manual setting Automatic setting corresponding to average power of signal applied	AUTO	-	

Description of command	FW vers.
This command defines the mode for setting the maximum input level.	

[SENSe:]LEVel:REFerence <*Level*>				Reference level for spectrum
<Level>	Parameter description	Def. value	Default unit	Unit ring
–100 dBm to +47 dBm	Reference level for RF 1	+30	dBm	
–100 dBm to +33 dBm	Reference level for RF 2	+30		
–100 dBm to 0 dBm	Reference level for RF 4 IN	0.0		
Command description				FW vers.
This command defines the reference level for *Spectrum* measurements.				≥ V 1.20

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* contains the commands for determination of the trigger mode. It corresponds to the index card *Trigger* in the popup menu *Group Configuration*.

TRIGger[:SEQuence]:SOURce <*Source*> — Trigger source

<*Source*>	Parameter description	Def. value	Default unit	Unit ring
IMMediate |	Continuous measurement (without reference to input signal)	IMM	–	
RFPower |	The RF signal controls triggering depending on the trigger level (`TRIG:SEQ:THR`)			
IFPower |	The IF signal controls triggering depending on the trigger level (`TRIG:SEQ:THR`)			
EXTern	External triggering (via connector AUX3)			

Command description	FW vers.
This command determines the trigger source.	≥ V 1.15

TRIGger[:SEQuence]:THReshold <*Threshold*> — Trigger threshold

<*Threshold*>	Parameter description	Def. value	Default unit	Unit ring
LOW |	Low trigger threshold (reference level - 26 dB)	MED	–	
MEDium |	Medium trigger threshold (reference level - 16 dB)			
HIGH	High trigger threshold (Reference level - 6 dB))			

Command description	FW vers.
This command sets the trigger level, i.e. the signal level at which the measurement is triggered (see `TRIG:SEQ:SOUR`). The command is enabled for trigger source `RFPower` and `IFPower` only.	≥ V 1.15

TRIGger[:SEQuence]:SLOPe <*Slope*> — Trigger slope

<*Slope*>	Parameter description	Def. value	Default unit	Unit ring
POSitive |	Rising slope	POS	–	
NEGative	Falling slope			

Command description	FW vers.
This command determines the trigger slope. The command is disabled for trigger source `IMMediate`.	≥ V 1.15

TRIGger[:SEQuence]:DEFault — Default Settings

<*Enable*>	Description of parameters	Def. value	Def. unit	Unit ring
ON |	The parameters are set to their default values	ON	–	
OFF	The parameters differ from the default values (partially or totally)			

Description of command	FW vers.
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	

Connection Control

The remote-control commands presented in this section define the analyzer and generator settings, the inputs and outputs used as well as the reference frequency. They correspond to the settings in the popup menu of the *Connect. Control* softkey located to the right of the header of each main menu (see chapter 3).

Subsystem RFANalyzer (Analyzer Settings)

The subsystem *RFANalyzer* contains the commands for determination of the parameters for analyzer control. It corresponds to the *Analyzer Settings* panel in the index card *Signal* in the popup menu *Connect. Control.*

[SENSe:]RFANalyzer:FREQuency <*Frequency*> — RF frequency

<*Frequency*>	Parameter description	Def. value	Default unit	Unit ring
50 kHz to 2.7 GHz	Frequency (0.1 Hz resolution)	1000 MHz	Hz	

Command description	FW vers.
This command defines the input frequency of the analyzer. The usable frequency range exceeds the specified range, see data sheet.	≥ V 1.15

[SENSe:]RFANalyzer:BANDwidth[:RESolution] <*Bandwidth*>
[SENSe:]RFANalyzer:BWIDth[:RESolution] <*Bandwidth*> — Bandwidth

<*Bandwidth*>	Parameter description	Def. value	Default unit	Unit ring
10 Hz to 1 MHz | WIDE	Bandwidths of the analyzer (the values are rounded in the steps 1 | 2 | 3 | 5)	WIDE	–	

Command description	FW vers.
This command defines the bandwidth of the analyzer. If WIDE is set no restriction is placed on the input frequency.	≥ V 1.15

Measurement Object RFANalyzer

The subsystem *RFANalyzer:POWer* contains the commands for measuring the signal power. The subsystem corresponds to the measurement menu *Analyzer Generator* and the associated popup menu *Power Ramp Configuration.*

Subsystem RFANalyzer (Measurement Control)

The subsystem *RFANalyzer* contains the commands for general control of the RF analysis.

INITiate:RFANalyzer	Start new measurement	*RUN*
ABORt:RFANalyzer	Abort running measurement and switch off	*OFF*
STOP:RFANalyzer	Stop measurement after current evaluation period	*STOP*
CONTinue:RFANalyzer	Next measurement step (only *stepping mode*)	*RUN*

Command description	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.	≥ V 1.15

CONFigure:RFANalyzer:EREPorting <*Mode*> Event reporting of the measurement

<*Mode*>	Parameter description	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			

Command description	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).	≥ V 1.15

FETCh:RFANalyzer:STATus? Measurement status

Returned value	Parameter description	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current evaluation period			
NONE,	Counter not used	NONE	–	

Command description	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	≥ V 1.15

Subsystem RFANalyzer:CONTrol (Control)

CONFigure:RFANalyzer:CONTrol:REPetition <*Repetition*> ,<*StopCondition*>,<*Stepmode*>

Test cycles

<*Repetition*>	Parameter description	Def. value	Def. unit	Unit ring
CONTinuous | SINGleshot | 1 to 10000	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<*StopCondition*>	Parameter description	Def. value	Def. unit	Unit ring
NONE	Continue measurement even in case of error	NONE	–	
<*Stepmode*>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | NONE	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	

Command description — FW vers.

This command determines the number of statistics cycles and the stepping mode for the measurement. A stop condition is not available. — ≥ V 1.15

Note: *In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:RFANalyzer:POWer:RTIMe <Time> Duration of broadband power measurement

<*Time*>	Parameter description	Def. value	Def. unit	Unit ring
0 to 1	Duration of measurement. Accuracy: ± 5E-4 s	20E-4	s	

Command description — FW vers.

This command permits to define the time period during which the peak power is determined. With the time 0, the power is immediately measured on the measurement start, i.e. the instantaneous value is measured. — ≥ V 1.15

Subsystem RFANalyzer:POWer[:RESult] (Measured Values)

The subsystem *RFANalyzer:POWer[:RESULT]* contains the commands for reading the analyzer power. The subsystem corresponds to the *Analyzer Power* panel in the *Analyzer / Generator* menu.

READ[:SCALar]:RFANalyzer:POWer[:RESult]? Start single shot measurement and return results
FETCh[:SCALar]:RFANalyzer:POWer[:RESult]? Read out measurement results (unsynchronized)
SAMPle[:SCALar]:RFANalyzer:POWer[:RESult? Read out measurement results (synchronized)

Scalar measured values

Returned value	Description	Def. value	Default unit	Unit ring
-120.0 dBm to 47.0 dBm	RF power analyzed by the CMU	NAN	dBm	

Command description — FW vers.

These commands are pure queries. They start a measurement and return the scalar measurement result. — ≥ V 1.15

Generator Object RFGenerator

The subsystem *RFGenerator* contains the commands for determination of the parameters for control of the internal RF generator. It corresponds to the *RF Generator* panel in the index card *Signal* in the popup menu *Connect. Control* and in the measurement menu *Analyzer/Generator*.

Subsystem RFGenerator (Generator Control)

The subsystem *RFGENerator* contains the commands for general control of the RF generator.

INITiate:RFGenerator	Start RF generator, reserve resources	*RUN*
ABORt:RFGenerator	Switch off RF generator, release resources	*OFF*
Command description		FW vers.
These commands have no query form. They start or stop the RF generator, setting it to the status indicated in the top right column.		≥ V 1.15

FETCh:RFGenerator:STATus?				Generator status
Returned value	Parameter description	Def. value	Def. unit	Unit ring
OFF | **RUN |** **ERR**	Generator switched off (`ABORt` or `*RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	
Command description				FW vers.
This command is always a query. It returns the current generator status.				≥ V 1.15

Subsystem RFGenerator:LEVel (Level)

The subsystem *RFGenerator:LEVel* contains the commands for determination of the level of the internal RF generator. It corresponds to the input field *RF Level* of the *Generator* panel (in *Connection Control*, index card *Signal* and in the *Analyzer/Generator* menu).

SOURce:RFGenerator:LEVel <*Level*>				RF level
<Level>	Parameter description	Def. value	Def. unit	Unit ring
–137.0 to –27.0 dBm **–137.0 to –10.0 dBm** **–90.0 to +13.0 dBm**	RF1 level in the used timeslot RF2 level in the used timeslot RF 3 OUT level in the used timeslot	–27	dBm	
Command description				FW vers.
This command defines the RF generator level. The permissible value range depends on the used RF output of the CMU and the external attenuation.				≥ V 1.15

Subsystem RFGenerator:FREQuency (Frequency)

The subsystem *RFGenerator:FREQuency* contains the commands for determination of the frequency of the internal RF generator. It corresponds to the *Frequency* softkey of the *Generator* panel (in *Connection Control*, index card *Signal* and in the *Analyzer/Generator* menu).

SOURce:RFGenerator:FREQuency <*Frequency*>				RF frequency
<Frequency>	Parameter description	Def. value	Def. unit	Unit ring
100 kHz to 2.7 GHz	Output frequency (resolution 0.1 Hz)	1200 MHz	Hz	
Command description				FW vers.
This command defines the output frequency of the RF generator. The usable frequency range exceeds the specified range, see data sheet.				≥ V 1.15

Subsystem RFGenerator:MODulation (Frequency Modulation)

The subsystem *RFGenerator:MODulation* contains the commands for determination of the frequency modulation of the internal RF generator. It corresponds to the *Modulation* and *SSB Frequency* softkeys in the *Generator* panel (in *Connection Control*, index card *Signal* and in the *Analyzer/Generator* menu).

SOURce:RFGenerator:MODulation <*State*>				FM State (Mode)
<State>	Parameter description	Def. value	Def. unit	Unit ring
OFF | SSB	The output signal of the RF generator is not modulated. The output signal of the RF generator is modulated by the value set using `CONF:RFG:MOD:SSB:FREQ`.	OFF	–	
Command description				FW vers.
This command determines whether the output signal is modulated, i.e. whether the modulation specified with `CONF:RFG:MOD:SSB:FREQ` is applied.				≥ V 1.15

SOURce:RFGenerator:MODulation:SSB:FREQuency <*Deviation*>				FM Deviation (Offset)
<Deviation>	Parameter description	Def. value	Def. unit	Unit ring
-135.0 to +135.0 kHz	Frequency offset (resolution 10 Hz)	0 kHz	Hz	
Command description				FW vers.
This command defines the (single side band) offset frequency for modulation of the RF generator.				≥ V 1.15

Subsystem RFGenerator:FHOPping (Frequency Hopping)

The subsystem *RFGenerator:FHOPping* contains the commands for determination of the frequency hopping of the internal RF generator. It corresponds to the *Frequency Hopping* settings in the *Generator* Config. Popup in the index card *Hopping*.

SOURce:RFGenerator:FHOPping:STATe <State> — RF hopping status

<State>	Parameter description	Def. value	Def. unit	Unit ring
OFF | ON	No frequency hopping Frequency hopping active (between the frequencies set via `SOUR:RFG:FREQ` and `SOUR:RFG:FHOP:FREQ`)	OFF	–	

Command description — FW vers.

This command defines the hopping output frequency of the RF generator. This alternative frequency and the frequency set using `SOUR:RFG:FREQ` are used for hopping. The command `SOUR:RFG:FHOP:FREQ:MODE` decides whether the value is meant to be relative to `SOUR:RFG:FREQ` or absolute. — ≥ V 1.15

SOURce:RFGenerator:FHOPping:FREQuency *<Frequency>* — RF hopping frequency

<Frequency>	Parameter description	Def. value	Def. unit	Unit ring
absolute: **100.0 kHz to 2.7 GHz** **relative:** **depending on normal frequency**	Hopping frequency (in multiples of 0.1 Hz) within the rated generator frequency range	0 MHz (Hopping off)	Hz	

Command description — FW vers.

This command defines the hopping output frequency of the RF generator. This alternative frequency and the frequency set using `SOUR:RFG:FREQ` are used for hopping. The command `SOUR:RFG:FHOP:FREQ:MODE` decides whether the value is meant to be relative to `SOUR:RFG:FREQ` or absolute. — ≥ V 1.15

SOURce:RFGenerator:FHOPping:FREQuency:MODE <Mode> — RF hopping mode

<Mode>	Parameter description	Def. value	Def. unit	Unit ring
ABSolute | RELative	Hopping frequency Absolute with respect to the RF generator frequency Relative to the RF generator frequency	RELative	–	

Command description — FW vers.

This command decides whether the frequency set using `SOUR:RFG:FHOP:FREQ` is meant to be relative to `SOUR:RFG:FREQ` or absolute. — ≥ V 1.15

Subsystem RFGenerator:PULSe (Ramping)

The subsystem *RFGenerator:PULSe* contains the commands for determination of ramping mode of the internal RF generator. It corresponds to the *Ramping* setting in the *Generator Config.* menu in the index card *Hopping.*

SOURce:RFGenerator:PULSe:STATe <State>				Pulse (Ramping)
<State>	Parameter description	Def. value	Def. unit	Unit ring
OFF | **ON**	CW signal Pulsed signal with 577 µs burst length	OFF	–	
Command description				FW vers.
This command determines whether the RF generator generates a CW signal or a GSM-like burst signal.				≥ V 1.15

Subsystem RFGenerator:BANDwidth (Bandwidth)

The subsystem *RFGenerator:BANDwidth* contains the command for determination of the bandwidth of the modulation filter. It corresponds to the *Modulation Filter* setting in the popup menu *Generator Config.* in the index card *Modulation.*

SOURce:RFGenerator:BANDwidth[:RESolution] <*Bandwidth*> **SOURce:RFGenerator:BWIDth[:RESolution] <*Bandwidth*>**				Bandwidth
<Bandwidth>	Parameter description	Def. value	Default unit	Unit ring
OFF | **F30Khz |** **F300khz**	off (broadband) 30 kHz bandwidth 300 kHz bandwidth	F300	–	
Command description				FW vers.
This command defines the value of the modulation filter.				≥ V 1.15

Subsystem INPut, OUTPut, CORRection:LOSS (⟳/Ext. Att.)

The subsystem for input and output contains the commands for configuration of the input and output connectors. The subsystem corresponds to the index card ⟳/*Ext. Att.* in the popup menu *Connect. Control*.

INPut[:STATe] <*State*> Selection of input connectors

<*State*>	Parameter description	Def. value	Default unit	Unit ring
RF1	Connector RF1 used as input	RF1	–	
RF2	Connector RF2 used as input			
RF4	Connector RF4 IN used as input			

Command description	FW vers.
This command determines the connector to be used for incoming RF signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the very same measurement (see `OUTPut[:STATe]`). Only one input and one output may be active at a time, which is why the currently active one is automatically deactivated on switchover.	≥ V 1.15

OUTPut[:STATe] <*State*> Selection of output connectors

<*State*>	Parameter description	Def. value	Default unit	Unit ring
RF1	Connector RF1 used as output	RF2	–	
RF2	Connector RF2 used as output			
RF3	Connector RF3 OUT used as output			

Command description	FW vers.
This command determines the connector to be used for outgoing RF signals. The bidirectional connectors RF 1 and RF 2 can be used both as input and output connectors in the very same measurement. Only one input and one output may be active at a time, which is why the currently active one is automatically deactivated.	≥ V 1.15

[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] <*Absorption*>
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] <*Absorption*> External attenuation at input

<*Absorption*>	Parameter description	Def. value	Default unit	Unit ring
–50 dB to +50 dB	Value for external attenuation at Input <nr>, where <nr> = 1,2,4	0.0	dB	

Command description	FW vers.
This commands assigns an external attenuation value to the inputs of the instrument.	≥ V 1.15

[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude] <*Absorption*>
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude] <*Absorption*>> Ext. attenuation at output

<*Absorption*>	Parameter description	Def. value	Default unit	Unit ring
–50 dB to +50 dB	Value for external attenuation at output <nr>, where <nr> = 1,2,3	0.0	dB	

Command description	FW vers.
This command assigns an external attenuation value to the outputs of the instrument.	≥ V 1.15

Subsystem DM:CLOCk (Synchronization)

The subsystem *DM:CLOCk* contains the commands for setting a network-specific system clock. The subsystem corresponds to the index card *Sync.* in the popup menu *Connect. Control.*

SOURce:DM:CLOCk:STATe <*Mode*>		Network-specific system clock at REF OUT 2		
<Mode>	Parameter description	Def. value	Def. unit	Unit ring
ON | OFF	Switch system clock on/off	OFF	–	
Command description				FW vers.
This command switches the system clock at the output *REF OUT 2* on or off.				≥ V 1.15

SOURce:DM:CLOCk:FREQuency <Frequency>		Setting the reference frequency		
<Frequency>	Parameter description	Def. value	Def. unit	Unit ring
1.219 MHz to 39.000 MHz	Frequency of network-specific system clock	13	MHz	
Command description				FW vers.

This command defines the frequency at the output *REF OUT2*. The frequency entered is rounded to the following discrete values: ≥ V 1.15

39.000 MHz, 19.500 MHz, 13.000 MHz, 9.750 MHz, 7.800 MHz, 6.500 MHz, 5.571 MHz,
4.875 MHz, 4.333 MHz, 3.900 MHz, 3.545 MHz, 3.250 MHz, 3.000 MHz, 2.786 MHz,
2.600 MHz, 2.438 MHz, 2.294 MHz, 2.166 MHz, 2.053 MHz, 1.950 MHz, 1.857 MHz,
1.773 MHz, 1.696 MHz, 1.625 MHz, 1.560 MHz, 1.500 MHz, 1.444 MHz, 1.393 MHz,
1.349 MHz, 1.300 MHz, 1.258 MHz, 1.219 MHz

The formula of the sequence reads as follows:

$f_n = f_1 \frac{1}{n}$ with $n = 1, 2, 3, \ldots 32$ and $f_1 = 39$ MHz for RF

If the entered value f lies between two permissible discrete values f_n and f_{n+1}, it is rounded to

$f \rightarrow f_n$ if $f \geq f_1 \frac{1}{n+0.5}$ and

$f \rightarrow f_{n+1}$ if $f < f_1 \frac{1}{n+0.5}$.

Measurement Object POWer (Power vs. Time)

The subsystem *POWer* contains the commands for measurement of the signal power. The subsystem corresponds to the measurement menu *Power versus Time* and the associated popup menu *Power vs Time Configuration.*

Subsystem POWer (Measurement Control)

The subsystem *POWer* contains the commands for general control of the power measurement.

INITiate:POWer	Start new measurement	*RUN*
ABORt:POWer	Abort running measurement and switch off	*OFF*
STOP:POWer	Stop measurement after current evaluation period	*STOP*
CONTinue:POWer	Next measurement step (only *stepping mode*)	*RUN*

Command description	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.	≥ V 1.15

CONFigure:POWer:EREPorting <*Mode*> — Event reporting of the measurement

<Mode>	Parameter description	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Command description	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).	≥ V 1.15

FETCh:POWer:STATus? — Measurement status

Returned value	Parameter description	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
0 to 10000 |	Counter for evaluation periods (meas. cycles)	NONE	–	
NONE	Counter not used			

Command description	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	≥ V 1.15

Subsystem POWer:CONTrol (Control)

CONFigure:POWer:CONTrol <*Mode*> — Scope of measurement

<*Mode*>	Desciption of parameters	Def. value	Def. unit	Unit ring
SCALar | ARRay	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	

Description of command	FW-Vers.
This command specifies the type of measured values.	≥1.15

CONFigure:POWer:CONTrol:REPetition <*Repetition*> ,<*StopCondition*>,<*Stepmode*>

Measurement cycles

<*Repetition*>	Parameter description	Def. value	Def. unit	Unit ring
CONTinuous | SINGleshot | 1 to 10000	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<*StopCondition*>	Parameter description	Def. value	Def. unit	Unit ring
NONE	Continue measurement even in case of error	NONE	–	
<*Stepmode*>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | NONE	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	

Command description	FW vers.
This command defines the repetition mode and the stepping mode for the measurement. A stop condition is not available	≥ V 1.15
Note: *In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*	

DISPlay:POWer:CONTrol:GRID <*Enable*> — Grid

<*Enable*>	Parameter description	Def. value	Default unit	Unit ring
ON | OFF	Switch on grid lines Switch off grid lines	ON	–	

Command description	FW vers.
This command switches the grid lines on or off in the test diagram.	≥ V 1.15

Subsystem POWer:FREQuency (Frequency/RBW)

The subsystem *POWer:FREQuency* contains the commands for setting the frequency. The subsystem corresponds to the hotkey assignment *Frequency* in the graphical measurement menu *Power versus Time.*

[SENSe:]POWer:FREQuency:CENTer <*Frequency*>				RF frequency
<Frequency>	Parameter description	Def. value	Default unit	Unit ring
10 MHz to 2.7 GHz	Frequency (0.1-Hz resolution)	1000 MHz	Hz	
Command description				FW vers.
This command defines the input frequency of the analyzer.				≥ V 1.15

[SENSe:]POWer:FREQuency:BANDwidth[:RESolution] <*Bandwidth*> **[SENSe:]POWer:FREQuency:BWIDth[:RESolution] <*Bandwidth*>**				Bandwidth
<Bandwidth>	Parameter description	Def. value	Default unit	Unit ring
10 Hz to 1 MHz	Bandwidths of power measurement (the values are rounded in the steps 1 | 2 | 3 | 5)	300 kHz	–	
Command description				FW vers.
This command defines the bandwidth of the power measurement.				≥ V 1.15

Subsystem POWer:LEVel (Level)

The subsystem *POWer:LEVel* contains the commands for setting the levels. The subsystem corresponds to the hotkey assignment *Input Level* in the graphical measurement menu *Power versus Time.*

[SENSe:]POWer:LEVel:RANGe <*Range*>				Bandwidth
<Range>	Parameter description	Def. value	Default unit	Unit ring
10 dB to 100 dB	Level range of the power measurement (the values are rounded in the steps 1 | 2 | 3 | 5 | 8)	100 dB	–	
Command description				FW vers.
This command defines the level range of the *Power vs Time* measurement.				≥ V 1.15

Subsystem POWer:TIME

The subsystem *POWer:TIME* contains the commands for setting the time modes. The subsystem corresponds to the hotkey assignment *Time* in the graphical measurement menu *Power versus Time*.

[SENSe:]POWer:TIME:DELay <*Delay*>				Time delay
<Delay>	Parameter description	Def. value	Default unit	Unit ring
see below	Delay time between trigger time and start of the measurement	–10.0 µs	s	
Command description				FW vers.
This command defines the time when the measurement is started relative to the trigger time. The permissible range of delays depends on the timebase and bandwidth, e.g.: - 153 µs to 143 µs (bandwidth 1 MHz, span 10 µs) - 15.8694 s to 5.8694 s (bandwidth 10 Hz, timebase 10 s)				≥ V 1.15

[SENSe:]POWer:TIME:SPAN <*Span*>				Span
<Span>	Parameter description	Def. value	Default unit	Unit ring
10 µs to 10 s	Span of the power measurement	100 µs	s	
Command description				FW vers.
This command defines the span (i.e. the total evaluation time) of the *Power vs Time* measurement. The permissible spans depend on the selected bandwidth.				≥ V 1.15

CONFigure:POWer:CONTrol:TIMeout <*Timeout*>				Timeout for triggered measurements
<Timebase>	Parameter description	Def. value	Default unit	Unit ring
1 s to 1000 s	Timeout period after which the measurement is aborted	10 s	s	
Command description				FW vers.
This command defines a timeout period after which the measurement is aborted (e.g. if no trigger event could be detected).				≥ V 1.15

Subsystem POWer[:RESult]:BURSt (Measured Values)

The subsystem *POWer[:RESULT]:BURSt* contains the commands for measurement and output of the measured power versus the time. The subsystem corresponds to the graphical measurement menu *Power versus Time.*

CONFigure:ARRay:POWer:RANGe — Measurement range

Returned value	Parameter description	Def. value	Default unit	Unit ring
-15 s to 15 s,	Initial time for power measurement	Min	s	
1 to 500	number of test points and returned measured values	Max		

Command description — FW vers.

This command configures the commands `READ to , FETCh to` and `SAMPle:ARRay:POWer` by defining the test points on the time axis. The permissible range for the initial time and the number of test points depends on the span and the bandwidth set. — ≥ V 1.15

The minimum initial time is equal to the delay time defined via `POW:TIME:DEL`. The maximum initial time is equal to the mimumum initial time plus the span of the measurement defined via `POW:TIME:SPAN`.

The maximum number of measured values is 500 (500 samples). If the combination of values set implies that the allowed time range is exceeded, the number of samples is automatically adapted (reduced).

The measurement range can be set alternatively via the `POW:TIM:SPAN` command. In case of conflicting setting the CMU shows the following behavior:

- If the range (`CONF:ARR:POW:RANG`) is set after the span (`POW:TIM:SPAN`), an error message is generated.

If the span is set after the range, it supersedes the range defined before.

Power versus time

READ:ARRay:POWer[:RESult][:CURRent]? Start single shot measurement and return results

FETCh:ARRay:POWer[:RESult][:CURRent]? Read out measurement results (unsynchronized)

SAMPle:ARRay:POWer[:RESult][:CURRent]? Read out measurement results (synchronized)

Returned value	Parameter description	Def. value	Default unit	Unit ring
–128.0 dBm to + 47.0 dBm	Power values	NAN	dBm	

Command description — FW vers.

These commands are always queries. They return the power values versus the time. Starting point of the measurement and number of measurement results are defined in the command `CONFigure:ARRay:POWer:RANGe`. — ≥ V 1.15

Measurement Object SPECtrum

The subsystem *SPECtrum* contains the commands for measurement of the frequency spectrum. The subsystem corresponds to the measurement menu *Spectrum* and the associated popup menu *Spectrum Config.*

Subsystem SPECtrum (Measurement Control)

The subsystem *SPECtrum* contains the commands for general control of the spectrums. It corresponds to the *Spectrum.* softkey in the measurement menu *Spectrum.*

INITiate:SPECtrum	Start new measurement	*RUN*
ABORt:SPECtrum	Abort running measurement and switch off	*OFF*
STOP:SPECtrum	Stop measurement after current evaluation period	*STOP*
CONTinue:SPECtrum	Next measurement step (only *stepping mode*)	*RUN*

Command description	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.	≥ V 1.15

CONFigure:SPECtrum:EREPorting <*Mode*> — Event reporting of the measurement

<Mode>	Parameter description	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Command description	FW vers.
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).	≥ V 1.15

FETCh:SPECtrum:STATus? — Measurement status

Returned value	Parameter description	Def. value	Def. unit	Unit ring
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
0 to 10000 |	Counter for measurement cycles	NONE	–	
NONE	Counter not used			

Command description	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).	≥ V 1.15

Subsystem SPECtrum:CONTrol

The subsystem *SPECtrum:CONTrol* contains the commands for configuration of the spectrum measurement. It corresponds to the index card *Control* in the popup menu *Spectrum Configuration*.

CONFigure:SPECtrum:CONTrol <*Mode*>				Scope of measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	Unit ring
SCALar | **ARRay**	Scalar values only (incl. ramp matching) Scalar measured values and arrays	ARRay	–	
Description of command				FW-Vers.
This command specifies the type of measured values.				≥1.15

CONFigure:SPECtrum:CONTrol:REPetition <*Repetition*> ,<*StopCondition*>,<*Stepmode*>				Measurement cycles
<Repetition>	Parameter description	Def. value	Def. unit	Unit ring
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Parameter description	Def. value	Def. unit	Unit ring
NONE	Continue measurement in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	Unit ring
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	
Command description				FW vers.
This command defines the repetition mode and the stepping mode for the measurement. A stop condition is not available. **Note:** *In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				≥ V 1.15

DISPlay:SPECtrum:CONTrol:GRID <*Enable*>				Grid
<Enable>	Parameter description	Def. value	Default unit	Unit ring
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	
Command description				FW vers.
This command switches the grid lines on or off in the test diagram.				≥ V 1.15

Subsystem SPECtrum:FREQuency (Frequency/RBW)

The subsystem *SPECtrum:FREQuency* contains the commands for setting the frequency. The subsystem corresponds to the hotkey assignment *Frequency/RBW* in the graphical measurement menu *Spectrum*.

[SENSe:]SPECtrum:FREQuency:CENTer <*Frequency*>
[SENSe:]SPECtrum:FREQuency:SPAN <*Frequency*>
[SENSe:]SPECtrum:FREQuency:STARt <*Frequency*>
[SENSe:]SPECtrum:FREQuency:STOP <*Frequency*>

RF frequency

<*Frequency*>	Parameter description	Def. value	Default unit	Unit ring
10.000005 MHz to 2.699999995 GHz	center frequency	1105	MHz	
0.00001 MHz to 2.69999999 GHz	frequency span	2190		
10 MHz to 2.69999999 GHz	start frequency	10		
10.00001 MHz to 2.7 GHz	stop frequency	2200		

Command description	FW vers.
This command sets the center frequency and span or the start and stop frequency of the spectrum analyzer. Start and stop frequency are used for calculation of the other two frequencies.	≥ V 1.15

[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution] <*Bandwidth*>
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution] <*Bandwidth*>

Bandwidth

<*Bandwidth*>	Parameter description	Def. value	Default unit	Unit ring
10 Hz to 1 MHz | AUTO	Bandwidths of power measurement (the values are rounded in the steps 1 | 2 | 3 | 5)	300 kHz	–	

Command description	FW vers.
This command defines the bandwidth of the spectrum measurement.	≥ V 1.15

Subsystem SPECtrum:LEVel (Level)

The subsystem *POWer:LEVel* contains the commands for setting the level. The subsystem corresponds to the hotkey assignment *Input Level* in the graphical measurement menu *Spectrum*.

[SENSe:]SPECtrum:LEVel:RANGe <*Range*>

Dynamic range

<*Range*>	Parameter description	Def. value	Default unit	Unit ring
10 dB to 100 dB	Level range for the spectrum measurement.	100 dB	–	

Command description	FW vers.
This command defines the level range for the spectrum measurement. The input values are rounded in steps of 1 | 2 | 3 | 5 | 8.	≥ V 1.15

Subsystem SPECtrum[:RESult] (Measured Values)

The subsystem *SPECtrum[:RESULT]* contains the commands for measurement and output of the spectrum measurement. The subsystem corresponds to the various output elements in the graphical measurement menu *Spectrum*.

CONFigure:ARRay:SPECtrum:RANGe <*StartFrq*>,<*Samp*> — Measurement range

<StartFrq>,<Samp>	Parameter description	Def. value	Default unit	Unit ring
10 MHz to 2.69999999 MHz,	Start frequency for spectrum measurement	Min	Hz	
1 to 560	number of test points	Max	–	

Command description	FW vers.
This command configures the commands `READ ...` , `FETCh ...` and `SAMPle:ARRay:POWer` by defining the test points on the frequency axis and the start frequency. The maximum number of samples is 560. If the combination of values set implies that the allowed frequency range is exceeded, the number of samples is adapted automatically. The measurement range can be set alternatively via the `SPEC:FREQ:SPAN` command. In case of conflicting setting the CMU shows the following behavior: • If the range (`CONF:ARR:SPEC:RANG`) is set after the span (`SPEC:FREQ:SPAN`), an error message is generated. If the span is set after the range, it supersedes the range defined before.	≥ V 1.20

READ:ARRay:SPECtrum[:RESult][:CURRent]? — Start single shot measurement and return results
FETCh:ARRay:SPECtrum[:RESult][:CURRent]? — Read out meas. results (unsynchronized)
SAMPle:ARRay:SPECtrum[:RESult][:CURRent]? — Read out measurement results (synchronized)

Power versus time

Returned value	Parameter description	Def. value	Default unit	Unit ring
–120.0 dBm to + 47.0 dBm	Power values	NAN	dBm	

Command description	FW vers.
These commands are always queries. They return the results of the spectrum measurement. Start point of the measurement and number of test points (samples) are defined in the command CONFigure:ARRay:SPECtrum:RANGe	≥ V 1.15

Audio Generator and Analyzer (with Option CMU-B21)

Audio measurements form a separate function group (*Non Signalling* mode) with associated secondary address. The mode "Signalling" is not available for the function group *Audio*. However, it is possible to perform audio measurements while using the signalling modes from other function groups (e.g. establish a call to a mobile in function group *GSM900/1800/1900-MS Signalling* and switch over to perform additional audio measurements). Consequently, additional audio-related commands may be provided in other contexts (for example, see the `ROUTe:SPENcoder...` and `ROUTe:SPDecoder...` commands in the *GSM900/1800/1900-MS* function groups).

The *Audio* measurement is divided into the two subsystems for AF Generator (subsystem `AFGenerator`) and AF Analyzer (subsystem `AFANalyzer`) control. In remote control, two independent circuits are provided:

- In the primary audio circuit (subsystems `AFANalyzer[:PRIMary]...` and `AFGenerator[:PRIMary]`), the audio signals are applied to the connectors AF OUT (output, AF generator signal) and AF IN (input) on the CMU front panel. The primary audio circuit corresponds to the *Audio Analyzer/Generator* menu and the associated configuration menu.
- In the secondary audio circuit (subsystems `AFANalyzer:SECondary...` and `AFGenerator:SECondary`), the audio signals are applied to the connectors AUX 2 (output, AF generator signal) and AUX 1 (input) on the CMU front panel. The secondary audio circuit can not be controlled manually.

With the exception of the input and output connectors, the two audio circuits are identical. All remote control commands are analogous.

Measurement Object AFANalyzer

The measurement object AFANalyzer contains the commands for measuring the audio signal. It corresponds to the *Analyzer* softkey in the main menu *Audio Analyzer/Generator* and the associated output fields.

Subsystem AFANalyzer (Measurement Control)

The subsystem *AFAnalyzer* contains the commands for general control of the audio analysis.

		Analyzer
INITiate:AFANalyzer[:PRIMary] **INITiate:AFANalyzer:SECondary**	Start new AF measurement	*RUN*
STOP:AFANalyzer[:PRIMary] **STOP:AFANalyzer:SECondary**	Stop AF measurement after current evaluation period	*STOP*
ABORt:AFANalyzer[:PRIMary] **ABORt:AFANalyzer:SECondary**	Abort and switch off AF analyzer	*OFF*
CONTinue:AFANalyzer[:PRIMary] **CONTinue:AFANalyzer:SECondary**	Next measurement step (only stepping mode)	*RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the AF analyzer, setting it to the status given in the top right column.		≥ V2.10

CONFigure:AFANalyzer[:PRIMary]:EREPorting <*Mode*>
CONFigure:AFANalyzer:SECondary:EREPorting <*Mode*>

Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	Unit ring
SRQ |	Service request	OFF	–	
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			

Description of command	FW vers.
This command defines the events generated when the measurement is terminated or stopped (event reporting see chapter 5)	≥ V2.10

FETCh:AFANalyzer[:PRIMary]:STATus?
FETCh:AFANalyzer:SECondary:STATus?

Measurement Status

Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Measurement in the OFF state (`*RST` or `ABORt`)	OFF	–	
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	OFF (could not be started)			
STEP |	Stepping mode (`<stepmode> = STEP`)			
RDY ,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	

Description of command	FW vers.
This command is always a query. It returns the status of the measurement (see chapters 3 and 5) and the number of the current statistics cycle.	≥ V2.10

Subsystem AFANalyzer...:CONTrol (Control)

The subsystem *AFANalyzer:...CONTrol* contains the commands for the configuration of the audio analysis. It corresponds to the *Analyzer Configuration* popup menu.

CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition Test Cycles
CONFigure:AFANalyzer:SECondary:CONTrol:REPetition
<Repetition>, <StopCondition>, <Stepmode>

<Repetition>	Description of parameters	Def. value	Def. unit	Unit ring
CONTinuous | SINGleshot | 1 to 10000	Continuous measurement (until `STOP` or `ABORt`) Single shot measurement (until `Status = RDY`) Multiple measurement (counting, `until Status = STEP | RDY`)	SING	–	
<StopCondition>	**Description of parameters**	**Def. value**	**Def. unit**	**Unit ring**
NONE	Continue measurement even in case of error	NONE	–	
<Stepmode>	**Description of parameters**	**Def. value**	**Def. unit**	**Unit ring**
STEP | NONE	Interrupt measurement after each statistic cycle Continue measurement according to its rep. mode	NONE	–	

Description of command — FW vers.

This command determines the number of statistics cycles and the stepping mode for the measurement. A stop condition is not available. — ≥ V2.10

Note: *In the case or READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling *<Coupling>* AF Path Coupling
CONFigure:AFANalyzer:SECondary:CONTrol:COUPling *<Coupling>*

<Coupling>	Description of parameters	Def. value	Def. unit	Unit ring
AC | DC	AC coupling of AF path DC coupling of AF path	AC	–	

Description of command — FW vers.

This command determines the AF path coupling for measurements using the AF analyzer. — ≥ V2.10

CONFigure:AFANalyzer[:PRIMary]:CONTrol:DISTortion[:FREQuency] *<Frequency>* Frequency
CONFigure:AFANalyzer:SECondary:CONTrol:DISTortion[:FREQuency] *<Frequency>*

<Frequency>	Description of parameters	Def. value	Def. unit	Unit ring
20 Hz to 20000 Hz	Reference frequency for distortion measurement	1000	Hz	

Description of command — FW vers.

This command determines the reference frequency for the harmonic distortion measurement. — ≥ V2.10

Subsystem AFANalyzer...[:RESult] (Measured Values)

The subsystem *AFAnalyzer...[:RESult]* contains the commands for reading the results of the audio analysis.

READ[:SCALar]:AFANalyzer[:PRIMary][:RESult]?		Scalar Results
READ[:SCALar]:AFANalyzer:SECondary[:RESult]?	Start single shot meas. and return results	
FETCh[:SCALar]:AFANalyzer[:PRIMary][:RESult]?		
FETCh[:SCALar]:AFANalyzer[:PRIMary][:RESult]?	Read out meas. results (unsynchronized)	
SAMPle[:SCALar]:AFANalyzer[:PRIMary][:RESult]?		
SAMPle[:SCALar]:AFANalyzer[:PRIMary][:RESult]?	Read out meas. results (synchron.)	

Return	Description of parameters	Def. value	Def. unit	Unit ring
PeakVoltage	0 V to 42.4 V	NAN	V	
RMSVoltage	0 V to 30 V	NAN	V	
DCVoltage	0 V to 30 V	NAN	V	
Distortion	0% to 100%	NAN	%	

Description of command	FW vers.
These commands are always queries. They start a measurement and output all scalar measurement results. These are: Peak and RMS value of AC voltage DC voltage Total harmonic distortion	≥ V2.10

Generator Object AFGenerator

The subsystem AFGenerator contains the commands for controlling and configuring the internal AF generator. It corresponds to the measurement softkey *Generator* in the measurement menu *Audio Analyzer/Generator* and the associated input fields.

INITiate:AFGenerator[:PRIMary]		AF Generator Control
INITiate:AFGenerator:SECondary	Start AF generator, reserve resources	*RUN*
ABORt:AFGenerator:[PRIMary]		
ABORt:AFGenerator:SECondary	Switch off AF generator, release resources	*OFF*

Description of command	FW vers.
These commands have no query form. They start and stop the AF generator, setting it to the status given in the top right column.	≥ V2.10

FETCh:AFGenerator[:PRIMary]:STATus?		Generator Status
FETCh:AFGenerator:SECondary:STATus?		

Return	Description of parameters	Def. value	Def. unit	Unit ring
OFF |	Generator switched off (`ABORt`, `*RST` or `OFF` due to conflict of resources)	OFF	–	
RUN |	Running (`INITiate`)			
ERR	Switched off (could not be started)			

Description of command	FW vers.
This command is always a query. It returns the current generator status.	≥ V2.10

SOURce:AFGenerator[:PRIMary]:LEVel <*Level*> SOURce:AFGenerator:SECondary:LEVel <*Level*>				Level (RMS)
<*Level*>	Description of parameters	Def. value	Def. unit	Unit ring
10 µV to 5 V	AF generator voltage	1	V	
Description of command				FW vers.
This command determines the RMS voltage of the AF generator.				≥ V2.10

SOURce:AFGenerator[:PRIMary]:FREQuency <*Frequency*> SOURce:AFGenerator:SECondary:FREQuency <*Frequency*>				Frequency
<*Frequency*>	Description of parameters	Def. value	Def. unit	Unit ring
20 Hz to 20 kHz	AF-Generator frequency	1000	Hz	
Description of command				FW vers.
This command determines the AF generator frequency.				≥ V2.10

List of Commands

In the following, all remote-control commands of the function group RF Non-Signalling Mode implemented in the CMU will be listed with their parameters and page numbers. Generally, they are arranged alphabetically according to the **second** keyword of the command so that related commands belong to the same group. For a list of common commands see Table 6-1 on page 6.1.

Table 6-2 List of remote-control commands: CMU base system

Command	Parameters	Remarks	Page
Subsystem COMMunicate (interface parameters)			
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	with query	6.12
SYSTem:COMMunicate:SERial<1|2>:APPLication	–	query only	6.12
SYSTem:COMMunicate:SERial<1|2>:TRANsmit:PACE	XON|ACK|NONE	with query	6.13
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD	110 to 19200	with query	6.12
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITs	7|8	with query	6.13
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARity[:TYPE]	NONE|ODD|EVEN	with query	6.13
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:STOP	1|2	with query	6.13
Subsystem ERRor (error queue)			
SYSTem:ERRor?		query only	6.4
Subsystem MISCellaneous (keyboard settings)			
SYSTem:MISCellaneous:KBEep	ON|OFF	with query	6.15
SYSTem:MISCellaneous:KEYBoard	US|GR	with query	6.15
Subsystem MQueue (measurement queue)			
SYSTem:MQUeue[:COMPlete]:ITEM?	US|GR	query only	6.16
SYSTem:MQUeue[:COMPlete][:LIST]?	<Meas_Queue>	query only	6.16
Subsystem OPTions (options)			
SYSTem:OPTions:INFO?		query only	6.13
SYSTem:OPTions?		query only	6.14
Subsystem PRESet (general reset)			
SYSTem:PRESet		no query	6.16
Subsystem REMote (remote control)			
SYSTem:REMote:ADDRess:PRIMary	0 to 30	with query	6.11
SYSTem:REMote:ADDRess:SECondary	1 to 30,<Remote-FGrp-Name> | NONe	with query	6.11
*SEC	0 to 30		6.12
System STATus (status reporting system)			
STATus:OPERation:CMU:ALL	0 to 32767, ... , 0 to 32767	query only	6.7
STATus:OPERation:CMU:CLEar	–	no query	6.8
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:CONDition?		query only	6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle	0 to 32767	with query	6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:NTRansition	0 to 32767	with query	6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:PTRansition	0 to 32767	with query	6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[EVENt]?		query only	6.6

Command	Parameters	Remarks	Page
STATus:OPERation:CMU:SUM<nr>:CONDition?		query only	6.6
STATus:OPERation:CMU:SUM<nr>:ENABle	0 to 32767	with query	6.6
STATus:OPERation:CMU:SUM<nr>:NTRansition	0 to 32767	with query	6.6
STATus:OPERation:CMU:SUM<nr>:PTRansition	0 to 32767	with query	6.6
STATus:OPERation:CMU:SUM<nr>[EVENt]?		query only	6.5
STATus:OPERation:CONDition?		query only	6.5
STATus:OPERation:ENABle	0 to 32767	with query	6.5
STATus:OPERation:EVENt:SADDress?	<SecAddr>,<Fgrp>	query only	6.9
STATus:OPERation:NTRansition	0 to 32767	with query	6.5
STATus:OPERation:PTRansition	0 to 32767	with query	6.5
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.10
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.10
STATus:OPERation[EVENt]?		query only	6.4
STATus:PRESet	–	no query	6.9
STATus:QUEStionable:CONDition?		query only	6.8
STATus:QUEStionable:ENABle	0 to 32767	with query	6.8
STATus:QUEStionable:NTRansition	0 to 32767	with query	6.8
STATus:QUEStionable:PTRansition	0 to 32767	with query	6.8
STATus:QUEStionable[EVENt]?		query only	6.8
Subsystem SYNChronize (Reference frequency)			
CONFigure:SYNChronize:FREQuency:REFerence	10 kHz to 52 MHz	with query	6.17
CONFigure:SYNChronize:FREQuency:REFerence:MODE	INTernal | EXTernal	with query	6.17
Subsystem TIMe (system time)			
SYSTem:TIMe:DATe	YYYY,MM,DD	with query	6.15
SYSTem:TIMe:TZONe	-12 to +12,-59 to +59	with query	6.14
SYSTem:TIMe[:TIMe]	0 to 23,0 to 59,0 to 59	with query	6.14

Table 6-3 List of remote-control commands: RF measurements

Command	Parameters	Remarks	Page
Subsystem CORRection:LOSS (Ext. Attenuation)			
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.28
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.28
[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.28
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude]	–50 dB to 50 dB	with query	6.28
Subsystem DM:CLOCk (Synchronization)			
SOURce:DM:CLOCk:FREQuency	1.219 MHz to 39.000 MHz	with query	6.29
SOURce:DM:CLOCk:STATe	ON | OFF	with query	6.29
Subsystem LEVel (Input Level)			
[SENSe:]LEVel:ATTenuation	NORMal | LNOise | LDIStortion	with query	6.18
[SENSe:]LEVel:MAXimum	–37 dBm to +47 dBm	depending on input and ext. attenuation set	6.18
[SENSe:]LEVel:MODE	MANual | AUTO	with query	6.18
[SENSe:]LEVel:REFerence	–100 dBm to +47 dBm	depending on input and ext. attenuation set	6.19
Test object POWer (Power vs. Time)			
INITiate:POWer	–	no query	6.30
ABORt:POWer	–	no query	6.30
STOP:POWer	–	no query	6.30
CONFigure:POWer:CONTrol	SCALar | ARRay	with query	6.31
DISPlay:POWer:CONTrol:GRID	ON | OFF	with query	6.31
CONFigure:POWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE,STEP | NONE	with query	6.31
CONFigure:POWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.30
[SENSe:]POWer:FREQuency:BANDwidth[:RESolution]	10 Hz to 1 MHz	with query	6.32
[SENSe:]POWer:FREQuency:BWIDth[:RESolution]	10 Hz to 1 MHz	with query	6.32
[SENSe:]POWer:FREQuency:CENTer	100 kHz to 2.7 GHz	with query	6.32
[SENSe:]POWer:LEVel:RANGe	10 dB to 100 dB	with query	6.32
CONFigure:ARRAy:POWer:Range[?]	StartX, Count		6.34
FETCh:POWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 | NONE , 0 to 1000 | NONE	query only	6.30
[SENSe:]POWer:TIME:DELay	-1000.0 µs to +1000.0 µs	depending on timebase and bandwidth	6.33
[SENSe:]POWer:TIME:SPAN	10 µs to 10 s	depending on bandwidth	6.33
READ:ARRAy:POWer[:RESult][:CURRent]?	–128.0 dBm to +47.0 dBm	query only	6.34
Test object RFANalyzer (Power)			
INITiate:RFANalyzer	–	no query	6.22
ABORt:RFANalyzer	–	no query	6.22
STOP:RFANalyzer	–	no query	6.22
CONTinue:RFANalyzer	–	no query	6.22

Command	Parameters	Remarks	Page
[SENSe:]RFANalyzer:BANDwidth[:RESolution]	10 Hz to 1 MHz | WIDE	with query	6.21
[SENSe:]RFANalyzer:BWIDth[:RESolution]	10 Hz to 1MHz | WIDE	with query	6.21
CONFigure:RFANalyzer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE,STEP | NONE	with query	6.23
CONFigure:RFANalyzer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.22
[SENSe:]RFANalyzer:FREQuency	100 kHz to 2.7 GHz	with query	6.21
CONFigure:RFANalyzer:POWer:RTIMe	0 to xxx	with query	6.23
READ[:SCALar]:RFANalyzer:POWer[:RESult]?	-120.0 dBm to +47.0 dBm	query only	6.23
SAMPle[:SCALar]:RFANalyzer:POWer[:RESult]?	-120.0 dBm to +47.0 dBm	query only	6.23
FETCh:RFANalyzer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 | NONE , 0 to 1000 | NONE	query only	6.22
Generator object RFGenerator			
INITiate:RFGenerator	–	no query	6.24
ABORt:RFGenerator	–	no query	6.24
SOURce:RFGenerator:BANDwidth[:RESolution]	OFF | F30Khz | F300khz	with query	6.27
SOURce:RFGenerator:BWIDth[:RESolution]	<Bandwidth>	with query	6.27
SOURce:RFGenerator:FHOPping	100.0 kHz to 2.7 GHz	with query	6.26
SOURce:RFGenerator:FHOPping:FREQuency:MODE	ABSolute | RELative	with query	6.26
SOURce:RFGenerator:FHOPping:STATe	OFF | ON	with query	6.26
SOURce:RFGenerator:FREQuency	100.0 kHz to 2.7 GHz	with query	6.25
SOURce:RFGenerator:LEVel	-137.0 dBm to + 13.0 dBm	restricted for RF1 / 2	6.24
SOURce:RFGenerator:MODulation	OFF | ON	with query	6.25
SOURce:RFGenerator:MODulation:SSB:FREQuency	-135.0 kHz to +135.0 kHz	with query	6.25
SOURce:RFGenerator:PULSe:STATe	OFF | ON	with query	6.27
FETCh:RFGenerator:STATus?	OFF | RUN | ERR	query only	6.24
Subsystem TRIGger			
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.20
TRIGger[:SEQuence]:SLOPe	POSitive | NEGative	with query	6.20
TRIGger[:SEQuence]:SOURce	IMMediate | RFPower | IFPower | EXTern	with query	6.20
TRIGger[:SEQuence]:THReshold	LOW | MEDium | HIGH	with query	6.20
Test object SPECtrum			
INITiate:SPECtrum	–	no query	6.35
ABORt:SPECtrum	–	no query	6.35
STOP:SPECtrum	–	no query	6.35
CONFigure:SPECtrum:CONTrol	SCALar | ARRay	with query	6.36
DISPlay:SPECtrum:CONTrol:GRID	ON | OFF	with query	6.36
CONFigure:SPECtrum:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE, STEP | NONE	with query	6.36
CONFigure:SPECtrum:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.35
[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution]	10 Hz to 1 MHz | AUTO	with query	6.37
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution]	10 Hz to 1 MHz | AUTO	with query	6.37
[SENSe:]SPECtrum:FREQuency:CENTer	10.000005 MHz to 2.699999995 GHz	with query	6.37

Command	Parameters	Remarks	Page
[SENSe:]SPECtrum:FREQuency:SPAN	0.00001 MHz to 2.69999999 GHz	with query	6.37
[SENSe:]SPECtrum:FREQuency:STARt	10 MHz to 2.69999999 GHz	with query	6.37
[SENSe:]SPECtrum:FREQuency:STOP	10.00001 MHz to 2.7 GHz	with query	6.37
[SENSe:]SPECtrum:LEVel:RANGe	10 dB to 100 dB	with query	6.37
CONFigure:ARRAy:SPECtrum:Range	StartX, Count		6.38
FETCh:SPECtrum:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 | NONE , 0 to 1000 | NONE	query only	6.35
FETCh:ARRAy:SPECtrum[:RESult][:CURRent]?	–120.0 dBm to +47.0 dBm	query only	6.38
SAMPle:ARRAy:SPECtrum[:RESult][:CURRent]?	–120.0 dBm to +47.0dBm	query only	6.38
Subsystem INPut, OUTput (⟳)			
INPut[:STATe]	ON | OFF	with query	6.28
OUTPut[:STATe]	ON | OFF	with query	6.28

Table 6-4 List of remote-control commands: AF Generator and Analyzer

Command	Parameters	Remarks	Page
Subsystem AFANalyzer			
INITiate:AFANalyzer:SECondary	–	no query	6.39
STOP:AFANalyzer:SECondary	–	no query	6.39
ABORt:AFANalyzer:SECondary	–	no query	6.39
CONTinue:AFANalyzer:SECondary	–	no query	6.39
CONFigure:AFANalyzer:SECondary:CONTrol:COUPling	AC | DC	with query	6.41
CONFigure:AFANalyzer:SECondary:CONTrol:DISTortion [:FREQuency]	100 Hz to 10000 Hz	with query	6.41
CONFigure:AFANalyzer:SECondary:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.41
CONFigure:AFANalyzer:SECondary:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.40
READ[:SCALar]:AFANalyzer:SECondary[:RESult]?	–	query only	6.42
FETCh[:SCALar]:AFANalyzer:SECondary[:RESult]?	–	query only	6.42
SAMPle[:SCALar]:AFANalyzer:SECondary[:RESult]?	–	query only	6.42
INITiate:AFANalyzer[:PRIMary]	–	no query	6.39
STOP:AFANalyzer[:PRIMary]	–	no query	6.39
ABORt:AFANalyzer[:PRIMary]	–	no query	6.39
CONTinue:AFANalyzer[:PRIMary]	–	no query	6.39
CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling	AC | DC	with query	6.41
CONFigure:AFANalyzer[:PRIMary]:CONTrol:DISTortion [:FREQuency]	100 Hz to 10000 Hz	with query	6.41
CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.41
CONFigure:AFANalyzer[:PRIMary]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.40
FETCh:AFAnalyzer[:PRIMary]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.40
FETCh:AFAnalyzer[:PRIMary]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.40
READ[:SCALar]:AFANalyzer[:PRIMary][:RESult]?	–	query only	6.42
FETCh[:SCALar]:AFANalyzer[:PRIMary][:RESult]?	–	query only	6.42
SAMPle[:SCALar]:AFANalyzer[:PRIMary][:RESult]?	–	query only	6.42
Subsystem AFGenerator			
INITiate:AFGenerator:SECondary	–	no query	6.42
ABORt:AFGenerator:SECondary	–	no query	6.42
SOURce:AFGenerator:SECondary:FREQuency	20 Hz to 20 kHz	with query	6.43
SOURce:AFGenerator:SECondary:LEVel	10 µV to 5 V	with query	6.43
FETCh:AFGenerator:SECondary:STATus?	OFF | RUN | ERR	query only	6.42
INITiate:AFGenerator[:PRIMary]	–	no query	6.42
ABORt:AFGenerator[:PRIMary]	–	no query	6.42
SOURce:AFGenerator[:PRIMary]:FREQuency	20 Hz to 20 kHz	with query	6.43
SOURce:AFGenerator[:PRIMary]:LEVel	10 µV to 5 V	with query	6.43
FETCh:AFGenerator[:PRIMary]:STATus?	OFF | RUN | ERR	query only	6.42

Alphabetical Command List

Table 6-5 Alphabetical list of remote-control commands

Command (Non Signalling, alphabetical)	Page
ABORt:AFANalyzer:SECondary	6.39
ABORt:AFANalyzer[:PRIMary]	6.39
ABORt:AFGenerator:SECondary	6.42
ABORt:AFGenerator[:PRIMary]	6.42
ABORt:POWer	6.30
ABORt:RFANalyzer	6.22
ABORt:RFGenerator	6.24
ABORt:SPECtrum	6.35
CONFigure:AFANalyzer:SECondary:CONTrol:COUPling	6.41
CONFigure:AFANalyzer:SECondary:CONTrol:DISTortion[:FREQuency]	6.41
CONFigure:AFANalyzer:SECondary:CONTrol:REPetition	6.41
CONFigure:AFANalyzer:SECondary:EREPorting	6.40
CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling	6.41
CONFigure:AFANalyzer[:PRIMary]:CONTrol:DISTortion[:FREQuency]	6.41
CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition	6.41
CONFigure:AFANalyzer[:PRIMary]:EREPorting	6.40
CONFigure:ARRAy:POWer:Range[?]	6.34
CONFigure:ARRAy:SPECtrum:Range	6.38
CONFigure:POWer:CONTrol	6.31
CONFigure:POWer:CONTrol:REPetition	6.31
CONFigure:POWer:EREPorting	6.30
CONFigure:RFANalyzer:CONTrol:REPetition	6.23
CONFigure:RFANalyzer:EREPorting	6.22
CONFigure:RFANalyzer:POWer:RTIMe	6.23
CONFigure:SPECtrum:CONTrol	6.36
CONFigure:SPECtrum:CONTrol:REPetition	6.36
CONFigure:SPECtrum:EREPorting	6.35
CONFigure:SYNChronize:FREQuency:REFerence	6.17
CONFigure:SYNChronize:FREQuency:REFerence:MODE	6.17
CONTinue:AFANalyzer:SECondary	6.39
CONTinue:AFANalyzer[:PRIMary]	6.39
CONTinue:RFANalyzer	6.22
DISPlay:POWer:CONTrol:GRID	6.31
DISPlay:SPECtrum:CONTrol:GRID	6.36
FETCh:AFAnalyzer[:PRIMary]:STATus?	6.40
FETCh:AFAnalyzer[:PRIMary]:STATus?	6.40
FETCh:AFGenerator:SECondary:STATus?	6.42
FETCh:AFGenerator[:PRIMary]:STATus?	6.42
FETCh:ARRAy:SPECtrum[:RESult][:CURRent]?	6.38
FETCh:POWer:STATus?	6.30
FETCh:RFANalyzer:STATus?	6.22
FETCh:RFGenerator:STATus?	6.24
FETCh:SPECtrum:STATus?	6.35
FETCh[:SCALar]:AFANalyzer:SECondary[:RESult]?	6.42
FETCh[:SCALar]:AFANalyzer[:PRIMary][:RESult]?	6.42
INITiate:AFANalyzer:SECondary	6.39
INITiate:AFANalyzer[:PRIMary]	6.39
INITiate:AFGenerator:SECondary	6.42
INITiate:AFGenerator[:PRIMary]	6.42
INITiate:POWer	6.30
INITiate:RFANalyzer	6.22
INITiate:RFGenerator	6.24
INITiate:SPECtrum	6.35
INPut[:STATe]	6.28
OUTPut[:STATe]	6.28
READ:ARRAy:POWer[:RESult][:CURRent]?	6.34
READ[:SCALar]:AFANalyzer:SECondary[:RESult]?	6.42

Command (Non Signalling, alphabetical) **Page**

READ[:SCALar]:AFANalyzer[:PRIMary][:RESult]? 6.42
READ[:SCALar]:RFANalyzer:POWer[:RESult]? 6.23
SAMPle:ARRAy:SPECtrum[:RESult][:CURRent]? 6.38
SAMPle[:SCALar]:AFANalyzer:SECondary[:RESult]? 6.42
SAMPle[:SCALar]:AFANalyzer[:PRIMary][:RESult]? 6.42
SAMPle[:SCALar]:RFANalyzer:POWer[:RESult]? 6.23
*SEC 6.12
[SENSe:]CORRection:LOSS:INPut<nr>[:MAGNitude] 6.28
[SENSe:]CORRection:LOSS:OUTPut<nr>[:MAGNitude] 6.28
[SENSe:]LEVel:ATTenuation 6.18
[SENSe:]LEVel:MAXimum 6.18
[SENSe:]LEVel:MODE 6.18
[SENSe:]LEVel:REFerence 6.19
[SENSe:]POWer:FREQuency:BANDwidth[:RESolution] 6.32
[SENSe:]POWer:FREQuency:BWIDth[:RESolution] 6.32
[SENSe:]POWer:FREQuency:CENTer 6.32
[SENSe:]POWer:LEVel:RANGe 6.32
[SENSe:]POWer:TIME:DELay 6.33
[SENSe:]POWer:TIME:SPAN 6.33
[SENSe:]RFANalyzer:BANDwidth[:RESolution] 6.21
[SENSe:]RFANalyzer:BWIDth[:RESolution] 6.21
[SENSe:]RFANalyzer:FREQuency 6.21
[SENSe:]SPECtrum:FREQuency:BANDwidth[:RESolution] 6.37
[SENSe:]SPECtrum:FREQuency:BWIDth[:RESolution] 6.37
[SENSe:]SPECtrum:FREQuency:CENTer 6.37
[SENSe:]SPECtrum:FREQuency:SPAN 6.37
[SENSe:]SPECtrum:FREQuency:STARt 6.37
[SENSe:]SPECtrum:FREQuency:STOP 6.37
[SENSe:]SPECtrum:LEVel:RANGe 6.37
SOURce:AFGenerator:SECondary:FREQuency 6.43
SOURce:AFGenerator:SECondary:LEVel 6.43
SOURce:AFGenerator[:PRIMary]:FREQuency 6.43
SOURce:AFGenerator[:PRIMary]:LEVel 6.43
SOURce:CORRection:LOSS:INPut<nr>[:MAGNitude] 6.28
SOURce:CORRection:LOSS:OUTPut<nr>[:MAGNitude] 6.28
SOURce:DM:CLOCk:FREQuency 6.29
SOURce:DM:CLOCk:STATe 6.29
SOURce:RFGenerator:BANDwidth[:RESolution] 6.27
SOURce:RFGenerator:BWIDth[:RESolution] 6.27
SOURce:RFGenerator:FHOPping 6.26
SOURce:RFGenerator:FHOPping:FREQuency:MODE 6.26
SOURce:RFGenerator:FHOPping:STATe 6.26
SOURce:RFGenerator:FREQuency 6.25
SOURce:RFGenerator:LEVel 6.24
SOURce:RFGenerator:MODulation 6.25
SOURce:RFGenerator:MODulation:SSB:FREQuency 6.25
SOURce:RFGenerator:PULSe:STATe 6.27
STATus:OPERation:CMU:ALL 6.7
STATus:OPERation:CMU:CLEar 6.8
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:CONDition? 6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle 6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:NTRansition 6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:PTRansition 6.7
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[EVENt]? 6.6
STATus:OPERation:CMU:SUM<nr>:CONDition? 6.6
STATus:OPERation:CMU:SUM<nr>:ENABle 6.6
STATus:OPERation:CMU:SUM<nr>:NTRansition 6.6
STATus:OPERation:CMU:SUM<nr>:PTRansition 6.6
STATus:OPERation:CMU:SUM<nr>[EVENt]? 6.5
STATus:OPERation:CONDition? 6.5
STATus:OPERation:ENABle 6.5
STATus:OPERation:EVENt:SADDress? 6.9

Command (Non Signalling, alphabetical) **Page**

STATus:OPERation:NTRansition 6.5
STATus:OPERation:PTRansition 6.5
STATus:OPERation:SYMBolic:ENABle 6.10
STATus:OPERation:SYMBolic[:EVENt]? 6.10
STATus:OPERation[EVENt]? 6.4
STATus:PRESet 6.9
STATus:QUEStionable:CONDition? 6.8
STATus:QUEStionable:ENABle 6.8
STATus:QUEStionable:NTRansition 6.8
STATus:QUEStionable:PTRansition 6.8
STATus:QUEStionable[EVENt]? 6.8
STOP:AFANalyzer:SECondary 6.39
STOP:AFANalyzer[:PRIMary] 6.39
STOP:POWer 6.30
STOP:RFANalyzer 6.22
STOP:SPECtrum 6.35
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 6.12
SYSTem:COMMunicate:SERial<1|2>:APPLication 6.12
SYSTem:COMMunicate:SERial<1|2>:TRANsmit:PACE 6.13
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD 6.12
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITs 6.13
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARIty[:TYPE] 6.13
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:STOP 6.13
SYSTem:ERRor? 6.4
SYSTem:ERRor? 6.4
SYSTem:MISCellaneous:KBEep 6.15
SYSTem:MISCellaneous:KEYBoard 6.15
SYSTem:MQUeue[:COMPlete]:ITEM? 6.16
SYSTem:MQUeue[:COMPlete][:LIST]? 6.16
SYSTem:OPTions:INFO? 6.13
SYSTem:OPTions? 6.14
SYSTem:PRESet 6.16
SYSTem:REMote:ADDRess:PRIMary 6.11
SYSTem:REMote:ADDRess:SECondary 6.11
SYSTem:TIMe:DATe 6.15
SYSTem:TIMe:TZONe 6.14
SYSTem:TIMe[:TIME] 6.14
TRIGger[:SEQuence]:DEFault 6.20
TRIGger[:SEQuence]:SLOPe 6.20
TRIGger[:SEQuence]:SOURce 6.20
TRIGger[:SEQuence]:THReshold 6.20

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Measuring the I/Q Spectrum of a Mobile 7.3

7 Remote Control – Program Examples

The program examples in this chapter are intended to give a short introduction to GPIB bus programming of the CMU illustrating some of the concepts discussed in Chapter 5. For examples involving optional function groups (network tests) refer to the relevant manuals, e.g. *CMU-K21/-K22/-K23*.

Secondary Address Handling

The following example explains how to handle primary and secondary addressing and how to perform a simple measurement with the CMU. In the example, remote control via the *National Instruments* GPIB bus driver (NI-488.2) and the programming language C is used. Once the addresses are assigned, the same commands can be used in different function groups.

```
// Include header files
#include <string.h>

/*  NI488.2 header file */
#include <decl.h>

// GPIB board index
#define BdIndx                  0

// Primary address
#define pad                     20

// Secondary address for Base Definition (National Instruments specific)
#define sad_BASE                96

// Secondary  Address for function groups definition
// (conforming to IEEE488.2)
#define _RF_NSig                 1
#define _GSM900MS_Sig            2
#define _GSM900MS_NSig           3
#define _GSM1800MS_Sig           4

#define sad_RF_NSig             sad_BASE + _RF_NSig
#define sad_GSM900MS_Sig        sad_BASE + _GSM900MS_Sig
#define sad_GSM900MS_NSig       sad_BASE + _GSM900MS_NSig
#define sad_GSM1800MS_Sig       sad_BASE + _GSM1800MS_Sig

// Timeout
#define tmo                     (int) 10

// EOT
#define eot                     (int) 1

// EOS
#define eos                     (int) 0

// Command definition for secondary address mapping
```

```
#define Map_Command              "SYST:REM:ADDR:SEC %d,\"%s\""

#define IdStr_RF_NSig                 "RF_NSig"
#define IdStr_GSM900MS_Sig       "GSM900MS_Sig"
#define IdStr_GSM900MS_NSig      "GSM900MS_NSig"
#define IdStr_GSM1800MS_Sig     "GSM1800MS_Sig "

// Variable declarations
int h_BASE;
int h_RF_NSig;
int h_GSM900MS_Sig;
int h_GSM900MS_NSig;
int h_GSM1800MS_Sig;

char InBuffer [100];
char Command [100];

// Request of the basesystem handle
h_BASE = ibdev (BdIndx, pad, sad_BASE, tmo, eot, eos);

// Mapping of secondary addresses for the function groups
sprintf (Command, Map_Command, _RF_NSig,IdStr_RF_NSig);
ibwrt(h_BASE, Command, strlen(Command));
sprintf (Command, Map_Command, _GSM900MS_Sig, IdStr_GSM900MS_Sig);
ibwrt(h_BASE,Command, strlen(Command));
sprintf (Command, "Map_Command _GSM900MS_NSig, IdStr_GSM900MS_NSig);
ibwrt(h_BASE,Command, strlen(Command));
sprintf (Command, "Map_Command _GSM1800MS_Sig, IdStr_GSM1800MS_Sig);
ibwrt(h_BASE,Command, strlen(Command));

// Request of function group handles
h_RF_NSig = ibdev (BdIndx, pad, sad_RF_NSig, tmo, eot, eos);
h_GSM900MS_Sig = ibdev (BdIndx, pad, sad_GSM900MS_Sig, tmo, eot, eos);
h_GSM900MS_NSig = ibdev (BdIndx, pad, sad_GSM900MS_NSig, tmo, eot, eos);
h_GSM1800MS_Sig = ibdev (BdIndx, pad, sad_GSM1800MS_Sig, tmo, eot, eos);
```

Simple Measurements

The following measurement examples require option CMU-K21/-K22/-K23 to be installed – see separate operating manual for GSM900/1800/1900 mobile tests.

```
// Example for a GSM900 mobile with power and
// modulation measurement at PCL 5 and PCL 10


ibwrt(h_GSM900MS_Sig, "PROC:SIGN:MS:PCL 5", 18);
ibwrt(h_GSM900MS_Sig, "READ:SCAL:POW:RES?", 18);
ibrd (h_GSM900MS_Sig, InBuffer, sizeof (InBuffer));
...
ibwrt(h_GSM900MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM900MS_Sig, InBuffer, sizeof (InBuffer));
...
ibwrt(h_GSM900MS_Sig, "PROC:SIGN:MS:PCL 10",19);
```

```
ibwrt(h_GSM900MS_Sig, "READ:SCAL:POW:RES?",18);
ibrd (h_GSM900MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM900MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM900MS_Sig, InBuffer,sizeof (InBuffer));
...

// Example for a GSM1800 mobile with a power and
// modulation measurement at PCL 5 and PCL 10


ibwrt(h_GSM1800MS_Sig, "PROC:SIGN:MS:PCL 5",18);
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:POW:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM1800MS_Sig, "PROC:SIGN:MS:PCL 10",19);
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:POW:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
...
ibwrt(h_GSM1800MS_Sig, "READ:SCAL:MOD:RES?",18);
ibrd (h_GSM1800MS_Sig, InBuffer,sizeof (InBuffer));
```

Measuring the I/Q Spectrum of a Mobile

GSM uses the GMSK modulation scheme with a symbol rate of 270.833 kBit/s and four different phases that can be occupied during one symbol interval. If a constant series of zeros or ones is transmitted, the rotation of the I/Q vector causes a side band at 270.833/4 Hz = 667.70825 Hz from the carrier. Compared to the side band, the original carrier frequency is suppressed by –30 dB to –40 dB. The following example program measures the carrier signal, the upper and the lower side band using the *RF Spectrum* and the *RF Power vs Time* measurement groups. No additional options are needed.

To keep the syntax as short and simple as possible, the programs were written with the aid of *Winbatch*, a batch job tool organizing and simplifying the transfer of commands and data between the controller and the instrument.

Winbatch uses device names such as *CMUBASE, CMUGSMNS, CMUGSMSIG* which are previously defined and assigned to the primary address, secondary address, and some general device settings. With these device names, a complete command line reads:

`CMUBASE: <CMU_Command>`

where `<CMU_Command>` may be any of the commands (setting commands or queries) specified within the function group and mode identified by the device name *CMUBASE*. Program sequences consisting of commands that are defined in several function groups and modes can be re-used with an exchanged device name.

In addition to these data transfer commands, *Winbatch* provides *WHILE, GOTO*, and *IF* statements to express conditions and define loops. Program examples utilizing these statements can be found in the manuals for network tests, e.g. *GSM900/1800/1900-MS*. For the following example, configure your *Winbatch* settings such that *CMUBASE* is the device name for the CMU *BASE* system and *CMURF* denotes function group *RF (Non Signalling)*.

```
ECHO ON

FPRINT ..........................................................................
FPRINT    INITIALISATION ROUTINE:
FPRINT    ASK FOR THE IDENTIFIER OF THE CMU, RESET THE INSTRUMENT,
FPRINT    DEFINE THE SECONDARY ADDRESSES FOR ALL AVAILABLE FUNCTION GROUPS
FPRINT ..........................................................................

CMUBASE: *IDN?                                  Identification query
CMUBASE: *RST;*OPC?                             Reset the instrument; prevent the following command
                                                    to be executed before *RST is complete
CMUBASE: *CLS                                   Clear output buffer, set status byte
CMUBASE: SYST:REM:ADDR:SEC 1,"RF_NSig"          Define function group RF Non Signalling; the CMU Base
                                                    system is always assigned secondary address 0

FPRINT ..........................................................................
FPRINT   CONNECTORS
FPRINT ..........................................................................

CMURF: INP:STAT RF2                             Define input connector RF2
CMURF: OUTP:STAT RF2                            Define output connector RF2

FPRINT ..........................................................................
FPRINT   RF GENERATOR SETTINGS
FPRINT ..........................................................................

CMURF: SOUR:RFG:FREQ 900 MHZ                    Set RF generator frequency
CMURF: SOUR:RFG:MOD SSB                         Switch on frequency offset (single side band modulation)
CMURF: SOUR:RFG:MOD:SSB:FREQ 67.7 KHZ           Set offset frequency
CMURF: INIT:RFG;*OPC?                           Switch on RF generator


FPRINT ..........................................................................
FPRINT   SPECTRUM ANALYZER SETTINGS
FPRINT   REFERENCE LEVEL ONLY EXISTS IN THE MANUAL MODE (Defines display area)
FPRINT ..........................................................................

CMURF: SENS:SPEC:FREQ:CENT 900 MHZ              Set center frequency for spectrum measurement
CMURF: SENS:SPEC:FREQ:SPAN 500 KHZ              Set frequency span
CMURF: SENS:SPEC:FREQ:BAND 20 KHZ               Set resolution bandwidth of the spectrum analyzer
CMURF: CONF:SPEC:CONT:REP SING,NONE,NONE        Single shot measurement, no stop on error

FPRINT ..........................................................................
FPRINT   SPECTRUM MEASUREMENT AT 900 MHZ + OFFSET 67.7 KHZ, 1 POINT
FPRINT ..........................................................................

CMURF: CONF:ARR:SPEC:RANG 900.0677 MHZ,1        Select single measurement point at 900.0677 MHz
CMURF: READ:ARR:SPEC?                           Start single shot spectrum measurement, wait until it is
                                                    terminated, and return result (1 value)

FPRINT ..........................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (SUPPRESSED CARRIER AT 900 MHZ)
FPRINT ..........................................................................

CMURF: CONF:ARR:SPEC:RANG 900 MHZ,1             Select single measurement point
CMURF: READ:ARR:SPEC?                           Start single shot spectrum measurement, wait until it is
                                                    terminated, and return result (1 value)

FPRINT ..........................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (THE OTHER SIDEBAND 900 MHZ - 67.7 KHZ)
FPRINT ..........................................................................

CMURF: CONF:ARR:SPEC:RANG 899.9323 MHZ,1        Select single measurement point
CMURF: READ:ARR:SPEC?                           Start single shot spectrum measurement, wait until it is
                                                    terminated, and return result (1 value)

FPRINT ..........................................................................
```

```
CMURF: ABOR:SPEC                          Abort spectrum measurement and free resources

FPRINT ..................................................................
FPRINT   PRODUCE A RAMPED SIGNAL
FPRINT ..................................................................

CMURF: SOUR:RFG:PULS:STAT ON;*OPC?        Select pulsed signal (as opposed to CW)

FPRINT ..................................................................
FPRINT   CONFIGURE THE POWER/T MEASUREMENT
FPRINT ..................................................................

CMURF: SENS:POW:FREQ:CENT 900.0677 MHZ    Set center frequency for power vs. time measurement
CMURF: SENS:POW:FREQ:BAND 20 KHZ          Set resolution bandwidth of the RF analyzer
CMURF: SENS:POW:TIME:SPAN 1MS             Set evaluation time of power measurement
CMURF: TRIG:SOUR IFP                      Trigger meas. by IF signal level (recommended)
CMURF: LEV:MAX -10                        Set expected maximum input level

CMURF: CONF:ARR:POW:RANG 3E-4,1           Select single measurement point at 0.3 ms
CMURF: CONF:POW:CONT:REP SING,NONE,NONE   Single shot measurement, no stop on error
CMURF: SYST:ERR?                          Read error queue
CMURF: INIT:POW                           Initiate power vs. time measurement

CMURF: READ:ARR:POW?                      Start single shot measurement, wait until it is
                                              terminated, and return result (1 value)

FPRINT ..................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (SUPPRESSED CARRIER AT 900 MHZ)
FPRINT ..................................................................

CMURF: SENS:POW:FREQ:CENT 900 MHZ         Set center frequency for power vs. time measurement
CMURF: READ:ARR:POW?                      Start single shot measurement, wait until it is
                                              terminated, and return result (1 value)

FPRINT ..................................................................
FPRINT   HAVE A LOOK AT SPECIFIC OFFSETS (THE OTHER SIDEBAND 900 MHZ - 67.7 KHZ)
FPRINT ..................................................................

CMURF: SENS:POW:FREQ:CENT 899.9323 MHZ    Set center frequency for power vs. time measurement
CMURF: READ:ARR:POW?                      Start single shot measurement, wait until it is
                                              terminated, and return result (1 value)

SETLOCAL                                  Quit remote control mode
```

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8 Maintenance and Interfaces

The following chapter contains information on the maintenance of the CMU.

Please follow the instructions in the service manual when exchanging modules or ordering spares. The order no. for spare parts can be found in the service manual.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and calibration.

Maintenance

The CMU does not require any special maintenance. Remove any contamination on the instrument by means of a soft cloth. Make sure that the air vents are not obstructed.

Storing and Packing

The CMU can be stored at the temperature range quoted in the data sheet. When stored for an extended period of time the instrument should be protected against dust.

The original packing should be used, particularly the protective covers at the front and rear, when the instrument is to be transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the instrument to protect it against mechanical damage.

Hardware Interfaces

GPIB Bus Interface

The standard instrument is equipped with an GPIB bus (IEC/IEEE-bus) connection. The interface connector labeled *IEEE 488 / IEC 625* is located on the rear panel of the instrument. A controller for remote control can be connected via the GPIB bus interface using a shielded cable.

Characteristics of the Interface

- 8-bit parallel data transfer,
- bidirectional data transfer,
- three-line handshake,
- high data transfer rate of max. 350 kByte/s,
- up to 15 devices can be connected,
- maximal length of the connecting cables 15 m (single connection 2 m),
- wired OR if several instruments are connected in parallel.

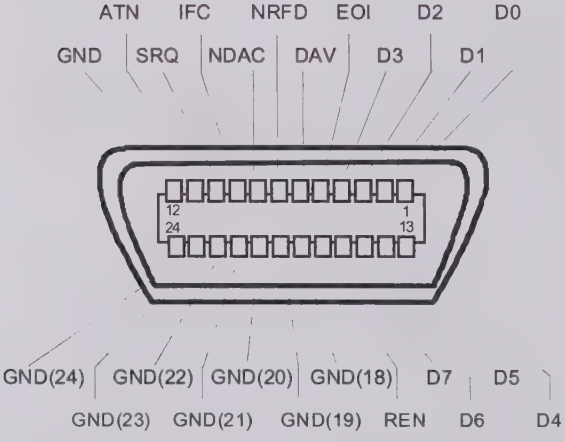


Fig. 8-1 Pin Assigment of the GPIB bus interface

Bus Lines

1. Data bus with 8 lines D0 to D7

The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.

2. Control bus with 5 lines

IFC (Interface Clear),
active LOW resets the interfaces of the instruments connected to the default setting.

ATN (Attention),
active LOW signals the transmission of interface messages
inactive HIGH signals the transmission of device messages.

SRQ (Service Request),
active LOW enables the connected device to send a service request to the controller.

REN (Remote Enable),
active LOW permits switchover to remote control.

EOI (End or Identify),
has two functions in connection with ATN:
ATN=HIGH active LOW marks the end of data transmission.
ATN=LOW active LOW triggers a parallel poll.

3. Handshake bus with three lines

DAV (Data Valid),
active LOW signals a valid data byte on the data bus.

NRFD (Not Ready For Data),
active LOW signals that one of the connected devices is not ready for data transfer.

NDAC (Not Data Accepted),
active LOW signals that the instrument connected is accepting the data on the data bus.

Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They serve to communicate between controller and instrument.

Universal Commands

Universal commands are encoded in the range 10 through 1F hex. They are effective for all instruments connected to the bus without pervious addressing.

Table 8-1 Universal Commands

Command	QuickBASIC command	Effect on the instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.

Addressed Commands

Addressed commands are encoded in the range 00 through 0F hex. They are only effective for instruments addressed as listeners.

Table 8-2 Addressed Commands

Command	QuickBASIC command	Effect on the instrument
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual control).

Note: *The CMU can not be configured as a high-speed HS488 listener; the commands CFE (Configure Enable) and CFGn (Configure) are not supported.*

Serial Interfaces (COM 1, COM 2)

The CMU is equipped with two serial RS-232-C interfaces. The two assigned 9-pin standard Sub-D male connectors are designated with COM 1 and COM 2 and located on the rear panel. A controller can be connected via this interface for remote control.

The two RS-232 interfaces provide two independent channels which can be active simultaneously. However, setting commands and queries act on the same device hardware. The interfaces are activated and configured in the *Setup - Remote* menu or via remote control using the commands `SYSTem:COMMunicate...`

Interface characteristics

- Serial data transmission in asynchronous mode,
- Bidirectional data transmission via two separate lines,
- Transmission rate selectable from 300 to 19200 baud,
- Logic 0 signal from +3 V to +15 V,
- Logic 1 signal from -15 V to -3 V,
- An external instrument (controller) can be connected,
- Hardware handshake RTS/CTS or software handshake XON/XOFF can be selected.

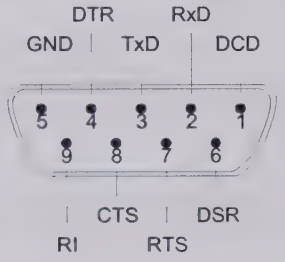


Fig. 8-2 Pin assignment of the RS-232-C interface

Designation	Abbreviation	Pin (9-pin male)	Pin (25-pin male)
Data Carrier Detect	DCD	1	8
Receive Data	RxD	2	3
Transmit Data	TxD	3	2
Data Terminal Ready	DTR	4	20
Signal Ground	GND	5	7
Data Set Ready	DSR	6	6
Request To Send	RTS	7	4
Clear To Send	CTS	8	5
Ring Indicator	RI	9	22

Signal lines

1. Data lines

RxD (Receive Data)
Input data.

Data transfer is bit-serial in the ASCII code, starting with the least significant bit (LSB).

TxD (Transmit Data)
Output data.

Data transfer is bit-serial in the ASCII code, starting with the least significant bit (LSB). The two data lines RxD and TxD are a minimum requirement for data transfer. The following control lines are necessary in addition if a hardware handshake is to be used.

2. Control and message lines

DCD (Data Carrier Detect)
active LOW.
Input; using this signal the data terminal recognizes that the modem of the remote station receives valid data with a sufficient signal level. DCD is used to disable the receiver in the data terminal and prevent reading of false data if the modem cannot interpret the signals of the remote station.

DTR (Data Terminal Ready)
active LOW,
Output; with DTR, the instrument indicates that it is ready to receive data.

DSR (Data Set Ready)
active LOW,
Input; DSR indicates to the instrument that the remote station is ready to receive data.

RTS (Request To Send)
active LOW.
Output; with RTS, the instrument indicates that it is ready to receive data. The RTS line controls whether the instrument is ready to receive data or not.

CTS (Clear To Send)
active LOW.
Input; CTS tells the instrument that the remote station is ready to receive data.

RI (Ring Indicator)
active LOW.
Input; RI is used by a modem to indicate that a remote station wants to set up a connection.

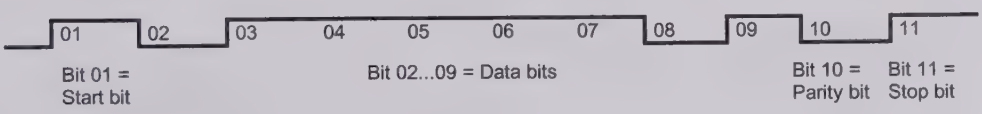
Transmission Parameters

In order to ensure error-free and correct data transmission, the parameters of the instrument and the controller must be set identically. The parameters of the RS-232 interface can be set via the *Setup - Remote* menu or the command group `SYSTem:COMMunicate...`

Table 8-3 Transmission parameters of the RS-232 interface

Parameter	Default	Description / Parameter Range
Baud rate	19200 Baud	The instrument allows baud rates between 110 and 19200 baud to be set, see chapter 4, *Setup - Remote* menu.
Data bits	8	Data transmission is in the 7- or 8-bit ASCII code, starting with the least significant bit (LSB).
Start bit	1	Each data byte begins with a start bit. The falling edge of the start bit indicates the beginning of the data byte.
Parity bit	None	A parity bit can be transmitted for error protection. The settings *No parity*, *even* or *odd* parity are allowed.
Stop bit	1	Transmission of a data byte is terminated by one or two stop bits. The sum of data bits and stop bits must be equal to 9.

Example: Transmission of character 'A' (41 Hex) in 8-bit ASCII code with even parity and one stop bit:



Interface functions

For interface control, some control characters from the ASCII code range of 0 to 20 hex are predefined and can be transmitted via the interface.

Table 8-4 Control strings or control characters of the RS-232-C interface

Control Character	Function
Break (at least 1 character only log 0)	Reset instrument
0Dhex, 0Ahex	Terminator <CR>, <LF> Switchover between local/remote

Handshake

Software handshake

In case of a software handshake data transfer is controlled using the two control characters XON / XOFF:

- The CMU uses the control character XON to indicate that it is ready to receive data.
- If the receive buffer is full it sends the XOFF character via the interface to the controller. The controller interrupts data output until it receives another XON from the CMU.
- In the same way the controller indicates to the CMU that it is ready to receive data.

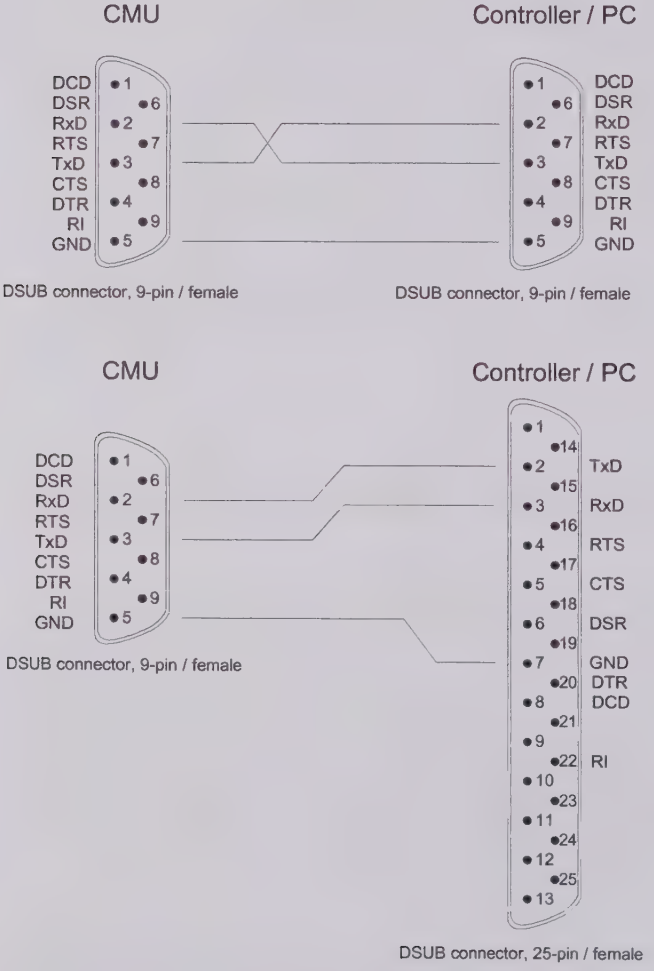


Fig. 8-3 Wiring of the data lines for software handshake

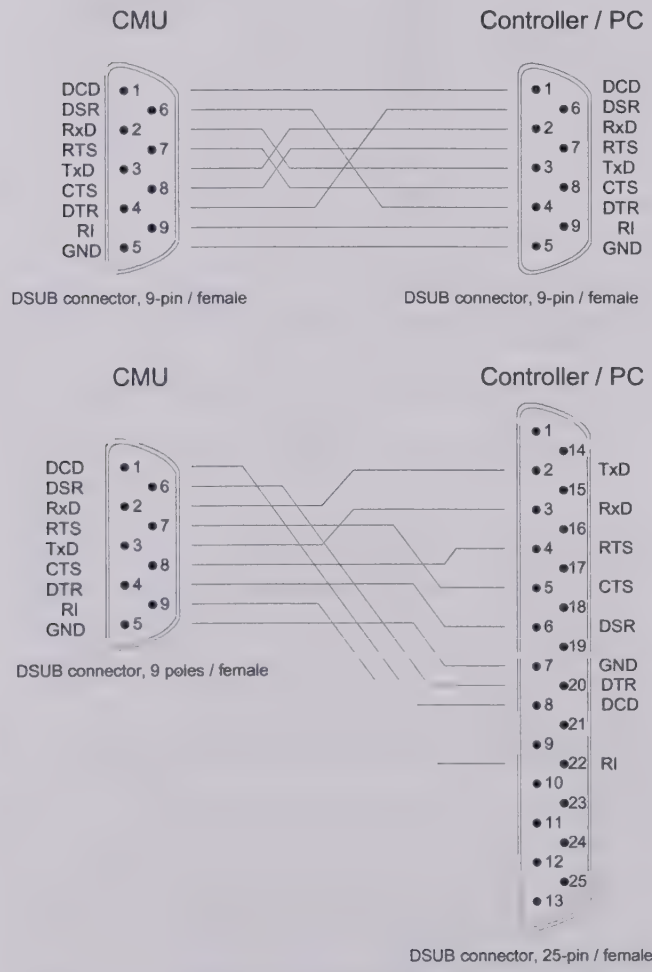
Connection between instrument and controller (Null-modem cable)

The connection of the instrument to a controller is made with a so-called null-modem cable. Here, the data, control and signalling lines must be crossed. The wiring diagram on the left applies to a controller with a 9-pin or 25-pin configuration.

Hardware handshake

In case of a hardware handshake, the instrument signals that it is ready for reception via line DTR and RTS. A logic '0' means "ready" and a '1' means "not ready". The RTS line is always active (logical '0'), provided that the serial interface is switched on. The DTR line controls whether the analyzer is ready for reception or not.

The CTS or DSR lines (see signal lines) tell the instrument whether the remote station is ready for reception or not. A logical '0' on both lines switches on data transmission, a logical '1' on both lines stops data transmission of the generator. The TxD line is used for data transfer.



Connection between instrument and controller (Null-modem cable)

The connection of the instrument to a controller is made with a so-called null-modem cable. Here, the data, control and signalling lines must be crossed. The wiring diagram on the left applies to a controller with a 9-pin or 25-pin configuration.

Fig. 8-4 Wiring of the data, control and message lines for hardware handshake

Connectors for Peripherals

Printer Connector (LPT)

The 25-pin standard Sub-D female connector LPT on the rear panel of the CMU is intended for connecting a printer. The interface is CENTRONICS compatible.

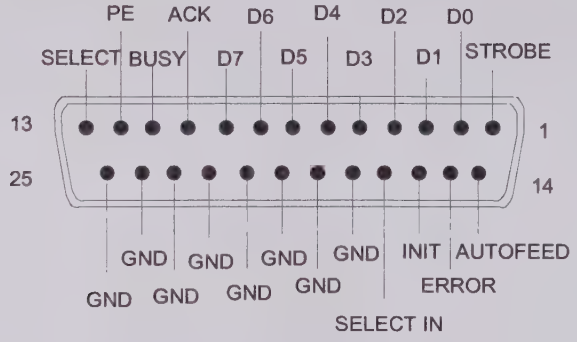
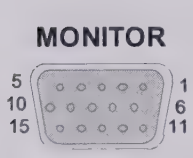


Fig. 8-5 Pin assignment of the LPT connector

Pin	Signal	Input (I) Output (O)	Description
1	STROBE	O	Impulse for transfer of a data byte, 1µs pulse width at minimum (active LOW)
2	D0	O	Data line 0
3	D1	O	Data line 1
4	D2	O	Data line 2
5	D3	O	Data line 3
6	D4	O	Data line 4
7	D5	O	Data line 5
8	D6	O	Data line 6
9	D7	O	Data line 7
10	ACK	I	Indicates that the printer is ready to receive the next byte (active LOW)
11	BUSY	I	Signal active if the printer is unable to receive data
12	PE	I	The signal is activated if no printer paper is available (active HIGH).
13	SELECT	I	The signal is activated when the printer is selected (active HIGH).
14	AUTOFEED	O	If the signal is active the printer inserts a line feed after each line (active LOW).
15	ERROR	I	The signal is activated if no printer paper is available or an error occurred (active LOW).
16	INIT	O	Initializing the printer (active LOW)
17	SELECT IN	O	If the signal is active the codes DC1/DC3 are ignored by the printer (active LOW).
18 - 25	GND		Connected to ground

Monitor Connector (MONITOR)

The 15-pin Sub-D female connector MONITOR at the rear panel of the CMU is intended for connecting an external VGA monitor.

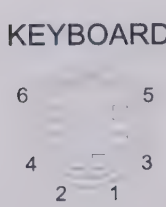


Pin No.	Signal
1	RED (output)
2	GREEN (output)
3	BLUE (output)
4	MID2 (NC)
5	NC
6	R-GND
7	G-GND
8	B-GND
9	NC
10	GND
11	MID0 (NC)
12	MID1 (NC)
13	HSYNC (output)
14	VSYNC (output)
15	NC

Fig. 8-6 Pin assignment of the MONITOR connector

Keyboard Connector (KEYBOARD)

The 6-pole Mini DIN female connector KEYBOARD at the rear of the instrument is intended for connecting an external keyboard. .



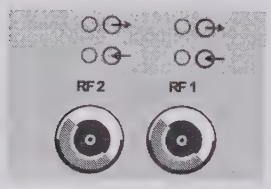
Pin No.	Signal
1	Keyboard data (input)
2	Msdata
3	GND
4	+5 V keyboard power supply (output, max. 0.1 A)
5	Keyboard clock (output)
6	Msclock
Shield	GND

Fig. 8-7 Pin assignment of the KEYBOARD socket

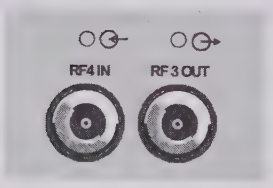
Signal Inputs and Outputs

RF Connectors

The N sockets on the front panel labeled RF1, RF 2, RF 3 OUT and RF4 IN are used as inputs and outputs for RF signals.



Bidirectional RF connectors

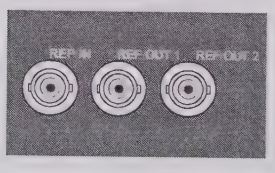


Unidirectional RF connectors

Fig. 8-8 RF connectors

Inputs and Outputs for the Reference Frequency (REF...)

The BNC sockets on the rear panel labeled REF IN, REF OUT 1 and REF OUT2 are used for synchronization of the CMU with external devices.



REF IN This input is used to synchronize the CMU to other instruments. The frequency of the external reference signal fed in at REF IN must be set in the *Sync.* index card of the *Connection Control* menu or via the `CONFigure:SYNChronize:FREQuency:REFerence` command.

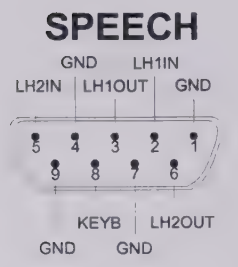
REF OUT 1 A signal for synchronization of other instruments is available at this output connector. This signal is either the reference frequency of the CMU or the signal applied to the input REF IN (see *Sync.* index card of the *Connection Control* menu).

REF OUT 2 A clock signal applied to this output and can be used for synchronizing external devices. The clock frequency can be selected from a list of network-specific frequencies in the *Sync.* index card of the *Connection Control* menu.

Fig. 8-9 Inputs and outputs for reference frequency

AF Connector SPEECH (Optional)

The 9-pin Sub-D female connector *SPEECH* on the front panel of the instrument can be used for connecting a handset to the signalling unit.

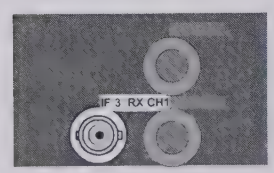


Pin No.	Signal	Input (I) / Output (O) / Bidirectional (B)	Description
1	GND	B	
2	LH1HAND SETIN	I	AF signals to signalling unit 1
3	LH1HAND SETOUT	O	AF signals from signalling unit 1
4	GND	B	
5	LH2HAND SETIN	I	Signals to signalling unit 2
6	LH2HAND SETOUT	O	Signals from signalling unit 2
7	GND	B	
8	+5VKEYB	O	Power supply +5.2 V, max. 100 mA
9	GND	B	

Fig. 8-10 AF connector SPEECH

IF Signal

One BNC connector providing an IF signal is located on the rear panel of the CMU.



IF3 RX CH1 connector (BNC socket), provides an IF signal from the RXTX board 1 for monitoring purposes.

Fig. 8-11 IF signal output

Service and Auxiliary Connectors

A 9-pin Sub-D female connector *SERVICE* for the modules RXTX Boards is located on the rear panel. This connector is intended for internal tests only and must not be used as a signal input or output.

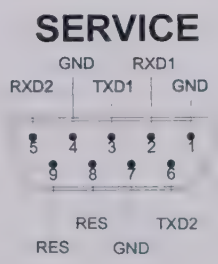
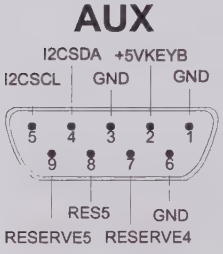


Fig. 8-12 SERVICE connector

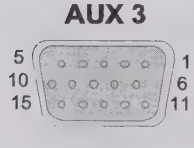
A 9-pin SUB-D female connector AUX on the rear panel provides a +5.2 V supply and an I^2C-bus connection for external components. The pin assignment is as follows:



Pin	Signal	Input (I) / Output (O) / Bidirectional (B)	Description
1	GND	B	GND
2	+5VKEYB	O	Power supply +5.2 V, max. 100 mA
3	GND	B	GND
4	I2CSDA	B	I2C-bus data
5	I2CSCL	O	I2C-bus clock
6	GND	B	GND
7	RESERVE4	B	
8	RESERVE5	B	
9	RESERVE6	B	

Fig. 8-13 RF connectors

The 15-pin SUB-D female connector AUX 3 on the front panel is used as an input or output for status, control, and trigger signals. These signals are applied to definite pins of the AUX 3 connector (refer to the corresponding menu).
The pin assignment of the AUX 3 connector is as follows:



Pin	Signal	Input (I) / Ausgang (A) / Bidirektional (B)	Description
1	GND	B	
2	TBUS1	B	Status/control/trigger signal
3	TBUS2	B	Status/control/trigger signal
4	TBUS3	B	Status/control/trigger signal
5	TBUS4	B	Status/control/trigger signal
6	TBUS5	B	Status/control/trigger signal
7	TBUS6	B	Status/control/trigger signal
8	TBUS7	B	Status/control/trigger signal
9	GND	B	GND
10	GND	B	GND
11	GND	B	GND
12	GND	B	GND
13	GND	B	GND
14	GND	B	GND
15	GND	B	GND

Fig. 8-14 AUX3 connector

The 15-pin SUB-D female connector AUX 4 on the rear panel is used as an input or output for status, control, and trigger signals. These signals are applied to definite pins of the AUX 4 connector (refer to the corresponding menu).
The pin assignment of the AUX 4 connector is as follows:

Pin	Signal	Input (I) / Ausgang (A) / Bidirektional (B)	Description
1	GND	B	GND
2	GND	B	GND
3	GND	B	GND
4	GND	B	GND
5	GND	B	GND
6	GND	B	GND
7	GND	B	GND
8	GND	B	GND
9	TBUS8	B	Status/control/trigger signal
10	TBUS9	B	Status/control/trigger signal
11	TBUS10	B	Status/control/trigger signal
12	TBUS11	B	Status/control/trigger signal
13	TBUS12	B	Status/control/trigger signal
14	TBUS13	B	Status/control/trigger signal
15	TBUS14	B	Status/control/trigger signal

Fig. 8-15 AUX4 connector

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9 Error Messages

SCPI Error Messages

SCPI error messages are the same in all SCPI instruments. The errors are assigned negative numbers. The standard text of the error message is often supplemented by a comment from thee CMU which provides more detailed information (device-dependent information). Since this part depends on the individual situation, it often contains more relevant information than the standard text.

No error

Error code	Explanation
0	**No error** This message is output when there are no entries in the error queue.

Command error

The following errors cause bit 5 in the ESR register to be set.

Error code	Explanation
-100	**Command error** Generic error message that cannot detect a more specific error.
-101	**Invalid character** The command contains a character which is invalid for that type.
-102	**Syntax error** The data type received is not accepted at this position.
-103	**Invalid separator** The semicolon was omitted after a program message unit.
-104	**Data type error** The recognized data element is of the wrong type (e.g. character data instead of numeric data)
-105	**GET not allowed** A GET was received within a program message.
-108	**Parameter not allowed** The command contains parameters at a position where they are not accepted.
-109	**Missing parameter** The command does not contain the required parameters.

Error code	Explanation
-111	**Header separator error** A character which is not a legal header separator was encountered while parsing the header; for example, no white space followed the header.
-112	**Program mnemonic too long** The header contains more than 12 characters.
-113	**Undefined header** The sent command header has not been defined.
-114	**Header suffix out of range** The command contains an illegal numeric suffix.
-120	**Numeric data error** An invalid character for the data type being parsed was encountered.
-121	**Invalid character in number** The command contains an illegal numeric suffix.
-123	**Exponent too large** The magnitude of the exponent is too large.
-124	**Too many digits** The decimal numeric data element contains too many digits.
-128	**Numeric data not allowed** The command contains a numeric data element the device does not accept in this position.
-131	**Invalid suffix** The suffix is not appropriate for this command.
-134	**Suffix too long** The suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this point of the command.
-141	**Invalid character data** The character data element contains an invalid character or the element is not valid for this command.
-144	**Character data too long** The character data element contains more than 12 characters.
-148	**Character data not allowed** The character data is prohibited for this command or at this point of the command.
-151	**Invalid string data** A string data element was expected, but was invalid for some reason.

Error code	Explanation
-158	**String data not allowed** The command contains a legal string data element which is not allowed at this point.
-161	**Invalid block data** The command contains illegal block data, e.g. no numeric data element is sent after the introductory #.
-168	**Block data not allowed** The command contains legal block data which are not allowed at this point.
-171	**Invalid expression** The expression data element was invalid; for example, unmatched parentheses or an illegal character.
-178	**Expression data not allowed** A legal expression data was encountered but was not allowed by the device at this point in parsing.
-180	**Macro error** An error occurred when defining a macro or executing a macro.

Execution error

The following errors cause bit 4 in the ESR register to be set.

Error code	Explanation
-200	**Execution error** An execution error as defined in IEEE 488.2, has occurred.
-203	**Command protected**
-211	**Trigger ignored** A triggering signal was received and recognized by the device but was ignored because of timing considerations.
-212	**Arm ignored** An arming signal was received and recognized by the device but was ignored.
-213	**Init ignored** A request for a measurement initiation was ignored as another measurement was already in progress.
-221	**Settings conflict** A setting contradicts another setting. The last attempted setting was not executed.
-222	**Data out of range** A value of the transmitted command was outside the legal range.
-223	**Too much data** More data were sent by the host than the CMU can handle.

Error code	Explanation
-224	**Illegal parameter value** An exact value, from a list of possible values, was expected but not received.
-225	**Out of memory** The CMU software has insufficient memory to perform the requested operation.
-230	**Data corrupt or stale** Possibly invalid data; new reading started but not completed since last access.
-240	**Hardware error** A legal program command or a query could not be executed because of a hardware problem in the device.
-241	**Hardware missing** A legal program command or a query could not be executed because of a missing device hardware.
-250	**Mass storage error** A mass storage error occurred.
-251	**Missing mass storage** A legal program command or a query could not be executed because of missing mass storage.
-252	**Missing media** A legal program command or a query could not be executed because of missing media; for example, no floppy disk.
-253	**Corrupt media** A legal program command or a query could not be executed because of corrupt media; for example, bad floppy disk or wrong format.
-254	**Media full** A legal program command or a query could not be executed because of the media was full; for example, no room on the floppy disk.
-255	**Directory full** The specified directory is full – no more files can be written.
-256	**File name not found** A file with the specified name does not exist.
-257	**File name error** The specified file name cannot be used, e.g. because the file does not exist (reading, clearing) or already exists (writing, generation).
-258	**Media protected** A legal program command or a query could not be executed because the media was protected.

Device-specific error

The following errors cause bit 3 in the ESR register to be set.

Error code	Explanation
-300	**Device-specific error**
-310	**System error** An unspecified system error has occurred.
-311	**Memory error** An error was detected in the device's memory.
-313	**Calibration memory lost** Nonvolatile calibration data have been lost.
-314	**Save/recall memory lost** Nonvolatile saved data have been lost.
-315	**Configuration memory lost** Nonvolatile configuration data saved by the device have been lost.
-330	**Self-test failed** An error occurred during the internal self test.
-350	**Queue overflow** Error code entered in the queue in lieu of the code when the queue is full. It indicates that an error occurred but was not recorded in the queue. The original error message is lost.
-360	**Communication error** An unspecified communication error was detected.
-361	**Parity error in program message** Parity bit was not correct when data were received on a serial port.
-362	**Framing error in program message** No stop bit was detected when data were received on a serial port.
-363	**Input buffer overrun** Software or hardware input buffer on serial port overflows with data caused by improper or nonexistent pacing.

Query error - error upon data request

When the following error codes are output, bit 2 is set in the ESR register.

Error code	Explanation
-400	**Query error**
-410	**Query INTERRUPTED** The query was interrupted. Example: a query is followed by new data before a response was completely sent.
-420	**Query UNTERMINATED** An incomplete query was received. Example: the device is addressed to talk although the received query was incomplete.
-430	**Query DEADLOCKED** A condition causing a DEADLOCKED query error occurred. Example: both input and output buffer are full and the device can not continue.
-440	**Query UNTERMINATED after indefinite response** A query was received in the same program message after a query requesting an indefinite response was execute.

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